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[OFFICIAL NOTICE.]

American Gas Light Association.

OFFICE AMERICAN GAS LIGHT ASSOCIATION,
142 CHAMBERS STREET, NEW YORK.

To the Members of the Association:

The Ninth Annual Meeting will be held in the city of Boston, Massachusetts, on the 19th, 20th and 21st days of October next. Headquarters during the meeting will be at the Hotel Brunswick. The meeting will be called to order at 11 A.M., Wednesday, 19th of October, in the large hall of the hotel.

Members intending to prepare papers are requested to notify the Secretary of the subject selected, so that the order of business may be arranged so as to give all an equal opportunity of being heard. Committees appointed at last annual meeting are respectfully reminded that they will be called upon for reports.

As every effort is being made to render this meeting full of interest, the Secretary trusts that each member will feel that some share of the responsibility for the success of this effort rests upon himself, and contribute, therefore, from the experiences and matured results of the past year to the general information. No subject bearing upon the vast interest represented in the Association is too trivial, or unworthy of careful investigation and report. Data of observations, results obtained in experimental or practical workings, old facts seen in new lights, or theories of management, all form a valuable basis upon which to found discussions or write papers. The object of these gatherings being to advance the interests of a common calling, it is binding upon all to add to the stock of information any fact that will throw more light upon it.

During the meeting the Association will be the guest of the New England Association of Gas Engineers, and the Boston Gas Light Company. The local Committee of Arrangements has provided in a complete manner for the social entertainment of the members. A sail on the harbor, a drive through the beautiful suburbs of Boston, and a dinner being prominent features in their programme.

Members wishing to reserve rooms, and those intending to bring ladies with them, are requested to communicate with M. S. Greenough, Esq., Chairman of Committee.

Blank applications for membership can be obtained at this office, where arrears of dues can also be paid until Sept. 30th.

WM. HENRY WHITE,
Secretary.

THE ELECTRICAL EXHIBITION IN PARIS.

This Exhibition, which has been organized under the auspices of the French Government, and carried out on an International scale, is now in full operation, and is one of the most remarkable displays that has ever been held. Nor is it merely a display or a show, for there are departments of the exhibition other than those which exhibit, under the many classifications of the catalogue, the wonderful variety of uses to which the subtle fluid is being practically applied to the affairs of daily life by individuals, by corporations great and small, and by governments of states and empires.

Distinguished scientists of all nations, and specialists in every branch of applied electricity, have gathered there for consultation, information and the acquirement of a better mutual understanding among themselves. So rapid has been the development of the practical uses of this agent that those devoting themselves to the investigation of the laws by which its action is governed have scarcely had time to devise and publish to others a language which shall convey clear and definite ideas as to the science of electricity. One of the chief things that will mark this exhibition as an era in electrical science will be the agreement arrived at as to terms to be used by electricians in the measurement of electric force. Heretofore there has been a multiplicity of "units" used by different men to convey practically the same idea, and each man would use the terms of the school in which he had been educated. The result has been that, to an outsider, it has been almost impossible to obtain a clear and distinct idea of the relative meaning of different writers. To no one is this more apparent than to electricians themselves, and one of the first labors undertaken by the Congress of Electricians held during the Exhibition, has been to adopt resolutions setting forth the

use of certain terms to convey certain meanings. Should this nomenclature be universally adopted, much progress will have been made towards bringing order out of confusion in discussing the scientific problems involved in the development of the practical application of electricity.

Mr. George Simon Ohm, a German physicist, more than fifty years ago set forth the law in accordance with which the electromotive force in a voltaic battery could be measured. The *unit* of this *force* is called a VOLT, after Volta; the unit of *resistance* is called an OHM. These are terms that have been tolerably well understood for some time, and are adopted by the Congress; and, in addition to these, other terms expressing relations between these two fundamental terms have been agreed to.

The current produced by a "Volt" in a conductor having an "Ohm" resistance is to be called an AMPERE, after a distinguished Frenchman who made important discoveries in electro-magnetism in 1822-1826, regarding the relations of electro-currents to themselves and to magnets.

The amount of electricity that an Ampére gives in *one second of time* is to be called a COULOMB, from the name of another notable investigator of the laws of electrical repulsion and attraction.

The name of Faraday is preserved by the adoption of the term FARAD which is to signify a unit of *capacity* in currents when the conditions are such that a "Coulomb" in a "Farad" gives a "Volt."

Thus we see the men of Science meeting together, and in the youth of electrical progress making for themselves a language—or, rather, agreeing upon the fundamental basis of a language yet doubtless to be largely enriched and extended. Truly, this is an age of specialties, and well-stored and evenly-balanced must be the mind that can carry, without frequent loss, the technicalities of almost any branch of Science.

Thus far we have viewed the Exhibition in what we deem its more important aspect as marking a way station on the great international highway of scientific progress. As to the display it certainly must be most interesting, for few people have an idea of the multitude of useful appliances which are actuated by electricity. How many of them are to be seen side by side, and a volume of many pages would be required to enumerate and explain them.

Two things at once strike the gas man as of interest to him on reading the accounts of the exhibit, viz., the lights, and the power required for them. Never before have so many and such a variety of electric lights been seen. The number is legion, and the horse power expended by no means contemptible. The effect of the lights is said to be "brilliant," "beautiful," "superb," etc., etc., according to the standpoint from which they are observed. But to the gas maker there is nothing of discouragement in the display. About one-fourth the ground floor of the building is occupied by the power required for the display, which is variously estimated as ranging in the neighborhood of three thousand-horse power. Here may be seen every kind of engine; but more conspicuous than any others, perhaps, are the gas engines, from fifty-horse power down to one or two. In fact, a most excellent opportunity is here offered to study gas engines. Besides the Otto, which is so well-known, and, as we believe, so costly, there are others, one of which, known as "Clarke's," made in Glasgow, has attracted much notice from its freedom from complicated parts, and also from the large power which it claims to develop in proportion to its size, as one of these engines, occupying no more space than a three-horse power Otto, is said to be capable of giving over six-horse power.

It is a new affair, only three of them having been made up to the present time; but if reports are true as to the efficiency of this motor for driving dynamo machines, there will be a very large field of usefulness in its application outside of electric generators.

One other point has been demonstrated by this exhibition, viz., that the use of electricity is not free from danger. The London *Observer*, of Sept. 24th, said—

"If the Paris Electrical Exhibition has practically illustrated the advantages of the various systems of electric lighting it has given a practical example of their dangers. The exhibition building has been four times set on fire by the electric current. In none of these cases was the fire due to anything which can be described as an accident. The breaking of the wire, or the too close approach of the wires to each other, may cause a flash which might set surrounding woodwork in a blaze; but none of the four fires in the exhibition building have been due to either of these causes. They have arisen from the heating of the wire by the too great force of the current it is made to carry. The principle of the incandescent lamp is that where the electric current meets with resistance and is not able to pass it turns into heat and so escapes. In the incandescent lamps the resistance is offered by a thin thread of carbon, which, becoming heated to intense whiteness in a vacuum where it cannot be consumed, gives off the light. Any piece of fine wire anywhere in the circuit will heat and glow in the same way, and will set fire to any inflammable substance with which it may come in contact.

"This is the origin of the fires in the Paris Exhibition. Some of the exhibitors have been too economical in the use of copper, have poured upon their wires a current they were too small to carry, and it has escaped as heat, to the damage of the surrounding woodwork. This is by no means an unexpected danger of electric lighting, but it is one which the public at large have not hitherto realised. The electric light was introduced into the British Museum on the ground of its absolute safety. It was popularly believed that we had in it a means of illuminating libraries and museums and other valuable public buildings without any risk of fire. This confidence was a little shaken when it was reported that a portion of burning carbon had fallen from one of the lamps and had burned a hole in a book in the museum library; but it was even then thought that absolute security would be found in the incandescent system of lighting, in which the carbon is shut out from all contact with the air, which, if it were accidentally let in, would only cause the carbon to go off in an instant flash. But here is a danger to which all systems are alike exposed."

Of course the householder could not smell the danger, and would only become aware of it when he found his premises on fire. These accidents have happened in New York city, through an electric light wire coming in contact with a telephone wire and setting fire to offices where the boxes were placed.

To condense the whole matter as to cost of electric lights into an estimate is not an easy matter; but of one thing there can be no doubt, viz., that for the arc lights there is practically required one-horse power per thousand candles, so-called, and for all the forms of incandescent lamps from 100 to 110 candles may be obtained per horse power in practical working.

These results we have given before, and there seems no reason for changing the figures from anything thus far developed by the electrical exhibition in Paris.

Improved Street Lighting in Boston.

The Boston Gas Light Company, of Boston, Massachusetts, is giving the citizens of that city an excellent example of what can be done in the way of improved street lighting by gas. A recent number of the *Manufacturers Gazette* contains the following account of what has already been done there in this direction:

"Since the introduction of the electric light for street lighting purposes the Boston Gas Light Company has been showing the people what can be accomplished with gas. Two lights have been put up, one in front of the City Hall, and the other in front of Masonic Temple. The light in front of the City Hall comes from a cluster of six fifty-candle power Bray burners, five of which are arranged so that, the extremities of the batwings meeting, a complete circle of light is formed, and the sixth is in the center. This burner and the lantern were designed and made under the direction of Mr. Lamson, superintendent at the works. The Masonic Temple burner is of English make, and is called the Sugg burner. The lantern and burner were both imported.

"This is of the Argand description, is formed of pierced rings of lava, and gives a light of 200-candle power.

"The company tried a burner of 400-candle power in this lantern for a few nights, but the argands are particularly sensitive to a variation in pressure, and it was found that it was not steady enough, and a return to the smaller light was made necessary. The company has just imported from France a number of Siemens burners, to which they will soon give a trial. The peculiarity of this burner is that the heat arising from the flame is conducted, through a tube, back to the light again, to assist combustion and give strength to the light. These large lights have been used with great success in London and Paris.

"Up to the present time the cluster burner has been proved by far the best, and as the bat-wing burners run as high as eighty-candle power, much better results may be expected than those we have from the City Hall lights."

American Institute of Mining Engineers.

The Harrisburgh meeting of the American Institute of Mining Engineers will commence on Tuesday, October 25th, and continue on the 26th, 27th, and 28th. Addresses of welcome are expected from the Governor of the state of Pennsylvania, and the Mayor of Harrisburgh.

The headquarters of the Institute will be at the Lochiel House, where a special rate has been obtained. Secretary Drown requests that those who intend to be present at the meeting will notify him as speedily as possible in order that he may be enabled to secure proper accommodations.

A very enjoyable programme has been arranged for the occasion, which includes a reception tendered by the citizens of Harrisburgh and their wives to the visiting members and ladies, on Wednesday evening, October 26th.

[From the "Review of Gas and Water Engineering."]

Southwest of England Association of Gas Managers.

The Seventh Semi-Annual Meeting of this Association was held at the Railway Hotel, Weston-super-Mare, on Tuesday, Sept. 13, Mr. G. Garnett, M.I.C.E., in the chair. The attendance of members was very large. Mr. H. Cockey, of Frome, was elected President for the ensuing year.

The President delivered the usual address, and after the conclusion of its delivery, the Association decided to hold its next meeting at Frome.

Mr. A. Edwards (Taunton) then read a paper on

THE COST OF CARBONIZING.

Mr. President and Gentlemen:—The cost of carbonizing may be said to include four things—namely, labor, wear and tear, fuel, and interest on plant.

The cost of labor varies very much with different localities; it will therefore be necessary to consider the cost at the minimum and maximum rates of pay as nearly as can be ascertained. Taking, then, the rate of 3s. 6d. per shift as the lowest wages, and 14,000 cubic feet per man per shift as the smallest quantity of gas produced for that sum; and taking also the rate of 4s. per shift, and 25,000 cubic feet, as the highest standard of pay and production, we can work out the relative cost per 1000 cubic feet as follows:

Cost at lowest rate of pay and production	3.00d.
Cost at highest rate of pay and production	1.92d.
Difference	1.08d.

or over a penny per 1,000 cubic feet.

The cost of the second item—wear and tear—is not so easily calculated, but a good basis to assume for this calculation is the comparative production per mouthpiece per 24 hours. Assuming that the maximum quantity of gas manufactured on any day is 1-200th part of the total quantity manufactured annually, it follows that for each million cubic feet made annually 5000 cubic feet would be required for the heaviest day's make. Suppose that one retort produces this 5,000 cubic feet, and, again, that in another works, or in the same works at a different period, each retort produces, say, 6,500 cubic feet per day, will there be a saving?

Take a works with a maximum daily make of 300,000 cubic feet. At 5,000 cubic feet per mouthpiece, 60 retorts would require to be in action, but at 6,500 cubic feet per mouthpiece, only 46 would be needed, and, if set in beds of fives, it is probable that nine settings instead of twelve might be made to produce the required quantity. In this way, the wear and tear of three settings for one year would appear to be saved. It is, however, to be noted that retorts which are worked to produce 6,500 cubic feet per day could not be relied upon for more than two seasons, while, if worked to 5,000 cubic feet only, three seasons' work might be got from them.

Taking then, the previous figures, if nine settings only were lighted, one-half (or four and a half settings on the average) would require to be renewed annually. If twelve settings are used, one-third only, or four settings, would require renewal.

Taking the normal or average rate of one penny per 1,000 cubic feet for wear and tear of retorts, one-eighth would, the writer thinks, have to be added as the extra cost for the higher rate of production.

The third term is that of "fuel." This is usually calculated as a percentage of the total quantity of the coke produced. A comparison of the quantities remaining for sale appears, however, to be more reliable.

Taking, then, 10s. per ton as the average value of coke; taking also 7 cwt. per ton of coal carbonized as the lowest quantity sold, and 10 cwt. as the highest, the return per thousand cubic feet, at 10,000 cubic feet per ton, would be—

Highest, 6d.; Lowest, 4.2d. Difference, 1.8d.

It is, however, necessary to add that in many cases the gross sum produced annually by the sale of coke may, in consequence of the limited demand, be as high, or even higher, where 7 cwt. per ton is sold as it would were 10 cwt. per ton available for sale. Further, that a large percentage of consumption by the furnaces is not of necessity allied to either high or low rates of production per mouthpiece, and cannot, therefore, be fairly charged against either system as such.

The last item of cost is that of "interest upon plant." This also is somewhat difficult to estimate, on account of the many causes which affect the cost of constructing plant. It will nevertheless, I think, be conceded that from £20 to £30 per mouthpiece will be the limit of cost of retorts and fittings, and about £20 per mouthpiece the approximate cost of house and covering in small and medium sized works. Taking the lower figure of £20 retorts and £20 house, together £40, as the cost of construction where 5,000 cubic feet per mouthpiece per day is produced, and the higher of £30 retorts and £20 house, together £50, where the production of 6,500 cubic feet per mouthpiece is attained, and the interest at 7 per cent. per annum (the modern statutory rate, without sliding scale or auction clauses) the cost for interest per 1,000 cubic feet will amount to—

At lowest rate of production	.672d.
At highest	.661d.
Difference	.011d.

By adding the figures for each system, as already given, we can now compare their relative economy. The item of coke is omitted for the reasons already given, combined with this further one, that it is an article of doubtful and varying value in most works of any size, the cost of the other item being constant, or nearly so.

Rate of Production.

	Cost at Lower.	Cost at Higher.
Labor	3.00d.	1.92d.
Wear and tear	1.00d.	1.125d.
Interest	.672d.	.661d.
	4.672d.	3.706d.

Difference per 1,000 cubic feet = .966d., or a penny nearly.

Against these calculations it may possibly be urged that high rates of production may be had without high rates of wages, of wear and tear, or of cost of construction. To elicit information on these points, if it exists, is one of the chief objects of reading this paper, and it is hoped that members present will freely add to, and correct if need be, the statements already made.

We have lately been advised on high authority that to regenerative furnaces we may look for further reducing the cost and simplifying the process of carbonizing; but hitherto the published evidence of any economy obtained in this country is, if not altogether lacking, of so meagre a character as to be actually valueless to practical men. No one who has followed the matter up as it has appeared in professional literature can doubt that, except where stage retort houses exist, or have to be built, the cost of construction, as compared with existing methods, would be largely increased. On the other side, I venture to say that, as yet, no evidence has been given that either in cost of labor, wear and tear, or fuel, any improvement can be effected over the best systems of carbonizing by direct heating in ordinary furnaces. It must also be remembered that should any settings of retorts heated by a regenerative furnace fail or get sick, in consequence of the numerous ills to which the system is heir, the loss and inconvenience resulting would be much greater than under the ordinary systems of working.

Into the many other points which have an intimate connection with this subject, such as the relative economy of high and low makes per ton of coal, best number of retorts per setting, etc., it is not proper to enter in the limits of a single paper, and the writer, therefore, in conclusion, begs your indulgence for the faults and imperfections of this communication, which he hopes will be corrected and amended by your collective wisdom and experience.

Discussion.

Mr. Edwards, replying to inquiries, said he included engine drivers' wages in the cost of carbonizing, but not the cost of trimming and stacking coals. He did not include cost of maintenance.

Mr. J. H. Lyon (Cosham) said that when at Macclesfield he obtained 10,179 cubic feet of gas per ton, but the cost for wages was higher than that named by Mr. Edwards. The carbonizing was 3.16d., the purifying .86d. (including time and labor), and the wear and tear 2.4d. per thousand cubic feet.

Mr. Edwards said he should like to tell Mr. Lyon that carbonizing can be done within the sums he had mentioned in his paper. Several of his neighbors had done so, and he believed some had done even better.

Mr. Henry Sainsbury (Trowbridge) remarked that in some towns the local authorities do the public lamp lighting, while in others the gas company employs lamplighters, and their wages are included in the accounts. This item would make a considerable difference.

Mr. T. W. R. White (Sherborne) inquired if the figures given by Mr. Edwards were based upon results obtained at any particular season of the year.

Mr. Edwards—They are taken out from several weeks during the winter.

Mr. White—At most works better results can be obtained during the winter months than in the summer.

The President gave the results obtained by him at Ryde last week. They were as follows:

Superintendence of engine, pressure, etc.	0.34d.
Carbonizing	2.30d.
Yard labor	1.16d.
General superintendence	0.85d.
Total	4.65d.

Mr. J. W. Helps (Weston super-Mare)—Could you tell us the amount of money paid in wages last week? These results are so very favorable that we should be glad of further information respecting them.

The President—About £17. He thought that the average for the year would bear out these results. He was happy to say he had no lamplighters' wages to include, for the average meter system was in use at Ryde, one meter to every ten lamps in zones of 25 feet altitude, and the corporation did the lighting and extinguishing. This arrangement saved him a great deal of trouble, as, under the old system, he sometimes had 50 or 60 complaints in one morning. He considered that the labor accounts required great attention, as gas managers are more likely to get on the wrong side with them than with anything else. If we take on a man to do a job that would last two or three days, very often he stays the week out. He would also like to remark that in his opinion, two years was quite long enough to use retorts. They had that morning (at the Weston-super-Mare Gas Works) seen some retorts that had been in action a very long time. After having obtained 6,000 or 7,000 cubic feet per diem from a retort for about two years, it pays well to get rid of it. He thought that at Ryde the average for the years' working was 6,210 cubic feet of gas per mouthpiece per day, the retorts being 9 ft. by 21 in. by 14 in., as commonly used in this district. He had three men on each shift at present, and they made 130,000 cubic feet per diem.

The Ammoniated Superphosphate Company's Dry Ammonia Process.

In our issue of Sept. 2, page 108, will be found mention of the formation of a company in London, England, which had for its object the economical recovery of ammonia from crude gas in the form of a solid manure or fertilizing agent. It was also stated at the time that Prof. Wanklyn and Mr. F. W. Hartley, the well-known gas engineer, were interested in the project. The London *Journal of Gas Lighting* contains the following further details concerning the process:

The Ammoniated Superphosphate Company now have their process at work at the Old Kent Road station of the South Metropolitan Gas Company, where, by the courtesy of Mr. G. Livesey, we have been permitted to see it in operation.

The idea contained in the invention is as simple as can well be imagined, and consists essentially of the use of ordinary commercial superphosphate of lime in a dry purifying box, just as lime or oxide of iron is employed. The superphosphate box is not intended to take the place of the usual purifying materials, as its office is entirely to deal with ammonia. The new process is designed rather with a view to do away with the scrubbers and washers which are necessary when water is used for the absorption of ammonia.

The principles of the process will, however, be best explained in the course of a description of the operations, as carried on at the Old Kent Road. Here the whole of the daily production of gas is purified in two sections of apparatus, wherein lime and oxide are used, as required, for the reduction of sulphur to the legal limits. At the commencement of one of these sections two extra purifiers are introduced, both of which contain three layers of superphosphate, each 8 inches deep. These boxes, therefore, take up the impure gas immediately after it has been condensed and partially washed to free it from tar. The superphosphate, before being placed in the purifiers, is dampened with ammoniacal liquor, to insure its complete alkaline reaction. In small works, all washing and scrubbing might possibly be dispensed with by this process; but where there is much gas made some washing is advantageous, for the following reasons: The gas is thereby rendered more free from tar than it would otherwise be; and this is naturally desirable. With this object the use of a frictional condenser would also present advantages. Furthermore, wherever there is a considerable quantity of ammoniacal liquor deposited in the hydraulic main and from the condensers, it is evidently desirable to wash the gas with this liquor, as the gas is thereby prepared for the superphosphate boxes, and the liquor is at the same time brought up to a saleable strength. In any case, however, the inventors of the new process, while approving and indeed recommending this modified and restricted washing, forbid the use of additional clean water. All ammonia, in short, which is not taken up by the hydraulic main liquor is left to be absorbed by the superphosphate.

As already stated, the dampened superphosphate is placed in the boxes just like lime, forming the first in the series. Its effect on the gas is marvelous—the ammonia is completely absorbed, and the action continues during a lengthened period. At the time of our visit to the Kent Road works the first of the two superphosphate boxes had been in use for 81 days; and although the gas after passing through it showed that its powers of complete absorption had ceased, it was still maintained in series, so that the material might slowly continue to be enriched with ammonia. The next box, which had been in action for 14 days, was just in its full activity; the gas after passing the lowest tray showed only a slight trace of ammonia, estimated at considerably less than two grains per 100 cubic feet, while the tests taken above the higher sieves did not show the faintest stain. The box, in fact, would still be good for several weeks' working. When it begins to stain at the outlet, the other box will be cleared out and refilled with fresh material, and will become the second in series; and so on. The purifiers in question are each about 968 square feet in area, and the two contain together about 120 tons of superphosphate. About 2,500,000 cubic feet of gas passes through these boxes daily.

The material when saturated is somewhat compacted, but is not hard, and is quite black. It is kept dry, although freely exposed to the air; and is then ready for sale as a manure of the highest class. It is a superphosphate of lime with about 10 per cent. of ammonia, thus forming what has been termed an "ideal guano."

The above is a general description of the process, without, of course, pretending to give those particulars which are only to be obtained on application to the proper quarter. In reference thereto a few remarks may be permitted. As will have already become prominent in this brief review of the process, while its success as a practicable means of obtaining ammonia from crude coal gas is unquestionable, its economical advantages remain to be proved. In itself it is nothing more than a method of doing certain work which has hitherto been accomplished in other ways. So far as the purification of gas from ammonia is concerned, the method of washing with water is well known to be quite as effective as anything can possibly be. The question is whether the bye-product thereby recovered—ammonia—is more valuable in the form of ammoniated superphosphate than as common liquor. And by value, in this case, it is meant to imply the value as a residual, per ton of coal carbonized, apart from all considerations as to the worth of the product in the market.

Strong ammoniacal liquor can be produced at any gas works above the smallest size, and sent away to the purchaser at an almost nominal expense for labor. All that is required is the structural arrangement of scrubbing or washing plant, with the attendant reservoirs of liquid; and, after this, a supply of water and a small apportionment of steam power for pumping. The facility with which the elimination of ammonia, and the partial reduction of other impurities, can be effected by water, has led to many attempts to conduct the entire purification of gas in closed vessels. The consummation is, indeed, the dream of the gas manager, to whom the necessity for the use of dry purifiers is a constant source of trouble. The Ammoniated Superphosphate Company bid us at once abandon the idea of closed-vessel purification, inasmuch as they actually take away some of the sealed apparatus that is already in use, and make an addition to the more objectionable type of purifying plant. Consequently, although ammonia with superphosphate in combination may be more valuable, weight for weight, than ammonia in union with water, the gas manager must not omit to calculate the cost of obtaining the two forms of residual. We do not say that the new process is more costly in working than the old, or even if it be, it might not still be the more profitable. It is merely a matter of money. If the dry product is worth more than the wet, in a higher ratio than any increase in the cost of obtaining it, then of course it will be to everyone's interest to make it. This would probably be the sole consideration in the case of large gas works, but there are other conditions in which the dry product may offer many attractions. In country places or agricultural districts, the Bolton and Wanklyn process presents the advantages of producing, in the ordinary working of gas manufacture, without special apparatus or extra labor or attention, a most valuable fertilizer, which should command a remunerative price. Under these circumstances, when the difference between hand labor and a steam power process is not so enormously accentuated as it is in an establishment where the make of gas is reckoned in millions of cubic feet daily, the use of superphosphate will probably commend itself as supplying a marked want. And even in cases where the ordinary production is so small as to render it extremely difficult to satisfactorily provide for the removal of gaseous ammonia by washing, the addition of a tray of superphosphate in the bottom of a purifier would be most beneficial to the gas, although the quantity of manure obtained might be altogether insignificant.

In conclusion, it may be generally accepted that a trial of the new process under the supervision of the Company's Consulting Engineer, Mr. F. W. Hartley, will speedily demonstrate that the success experienced at the South Metropolitan works is not exceptional. The patentees deserve much credit for the painstaking way in which they tested the efficiency of their plan previous to placing it before the public; and the fact that it is so largely adopted at the works where the preliminary trials were conducted—and where, moreover, the manufacture of gas is carried on under the most stringent regulations—is a testimonial which alone speaks volumes in its favor.

[The London *Journal* of Sept. 13 contains a communicated article on this

subject, from Mr. H. Leicester Greville, F.I.C., Chemist to the Commercial Gas Company. This article, together with the reply of Mr. Geo. Livesey, we here reproduce.—Ed.]

In a recent number of the *Journal* a notice was given of the use of superphosphate of lime as a purifying agent for the removal of ammonia. As the practical trial of the process is sufficiently advanced to warrant the formation of a company for the purpose of working it, it may possibly interest your readers to state briefly the chemistry involved in the use of the material, together with a few general observations on the process.

The substance called superphosphate of lime is known in chemical parlance by the very euphonious cognomen of tetra-hydric calcium-diphosphate. It is prepared by treating bone ash with sulphuric acid. The principal constituent of bone ash is calcium phosphate ($Ca_3\,2\,PO_4$). When this substance is acted upon by sulphuric acid the following action takes place:

$$Ca_3\,2\,PO_4 + 2\,H_2SO_4 + 4\,H_2O = Ca\,H_4P_2O_8 + 2\,Ca\,SO_4,\,2\,H_2O\,;$$

the products formed being superphosphate of lime ($CaH_4P_2O_8$) and gypsum or hydrated sulphate of lime ($CaSO_4,\,2\,H_2O$). Commercial superphosphate is therefore a mixture of true superphosphate with sulphate of lime.

Now when this material is placed in contact with gas containing carbonic acid and ammonia, the superphosphate would probably be converted into carbonate of lime ($CaCO_3$), while the ammonia would be retained as a phosphate—thus:

$$CaH_4P\,O_8 + CO_2 + 6\,NH_3 + H_2O = CaCO_3 + 2\,(NH_4)_3\,PO_4.$$

It is also possible for the hydrated sulphate of lime to be acted upon by carbonic acid and ammonia, with the formation of carbonate of lime and sulphate of ammonia—thus:

$$CaSO_4\,2\,H_2O + 2\,NH_3 + CO_2 = CaCO_3 + (NH_4)_2\,SO_4 + H_2O$$

If the action is complete, the mixture of tetra-hydric-calcium-diphosphate, and calcium sulphate or gypsum—which constitutes commercial superphosphate—would become converted into a mixture of carbonate of lime and phosphate and sulphate of ammonia; the money value of which as a manure would be considerable. It must, however, be remembered, when estimating the real value of this method of dealing with ammonia, that the *complete* action of the superphosphate can only take place in the presence of carbonic acid; and that it is, therefore, necessary to use the material on comparatively foul gas.

Our present method of trusting almost entirely to water for the absorption of ammonia, has the merit of not only efficiently removing ammonia, but of likewise taking out a large proportion of sulphuretted hydrogen and carbonic acid from the crude gas. The quantities of these gases so absorbed, if not removed at this stage of the purification, would have to be dealt with in the purifiers proper, requiring the use of larger vessels and of a larger amount of purifying material. For this reason I have always laid stress on the fact of scrubbers being regarded not only as plant for the removal of ammonia, but of having, in addition, a distinct function as purifiers.

Now, in the event of superphosphate of lime being employed in place of water for the absorption of ammonia, the whole purifying effect of the alkaline action of the ammonia would be lost, and the consequently increased cost of eventual purification from the extra quantities of carbonic acid and sulphuretted hydrogen must be, therefore, placed against any special advantages claimed for the use of the superphosphate.

In order to show that this view is not simply theoretical, but has a sound economical bearing, nothing will afford a better illustration than a few figures. Referring to a large series of carbonic acid and sulphuretted hydrogen determinations in the gas at the outlet of the scrubbers, and in the gas liquor (taken contingently with the amount of liquor produced), I find in practical working that the percentages of impurities removed by the ammonia are as follows:

Sulphuretted hydrogen	16 per cent.
Carbonic acid.....	34 "

these percentages being on the total amount of the impurities present in the crude gas. As about one-fourth of the amount of carbonic acid capable of being taken up by the ammonia would possibly be absorbed by the superphosphate, the 34 per cent. of carbonic acid must be reduced by a corresponding amount—becoming, therefore, 26 per cent. The practical bearing of these figures is simply that the extra work thrown upon general purification by the use of the superphosphate process would be 16 per cent. for the sulphuretted hydrogen, and 26 per cent. for the carbonic acid.

In conclusion, I may add that I have no wish to disparage the superphosphate process, which will stand or fall by its own general merits or demerits. My sole desire is an endeavor to show the whole conditions which would be involved by the use of the process in the event of its being generally adopted.

London, Sept. 17, 1881.

Sir—In Mr. Greville's article on the superphosphate process in your last number, allowance does not appear to me to have been made for the carbonic acid and sulphuretted hydrogen that are combined with the ammonia in the condensed liquor, and which are not in any way interfered with by superphosphate process.

As the condensed liquor amounts to 10 or 12 gallons to the ton, it is fair to assume that, by proper arrangements, one-half at least of the whole of the ammonia in the crude gas is combined with it.

Mr. Greville says he finds, in practical working, that "the percentages of impurities removed by the ammonia are as follows: Sulphuretted hydrogen, 16 per cent.; carbonic acid, 34 per cent.—these percentages being on the total amount of the two impurities present in the crude gas." And he then says: "The practical bearing of these figures is simply that the extra work thrown upon the general purification, by the use of the superphosphate process, would be 16 per cent. for the sulphuretted hydrogen, and 26 per cent. for the carbonic acid." He allows, therefore, 8 per cent. for the carbonic acid taken up by the superphosphate; but this is only a guess, which may safely be left in the hands of Professor Wanklyn. But, assuming it to be correct, the following would appear to be the proper percentages taken out of the crude gas: Sulphuretted hydrogen in the condensed liquor, one-half of Mr. Greville's quantity, or 8 per cent.; carbonic acid, do., do., 17 per cent.; carbonic acid taken out by the superphosphate, 8 per cent.—making 25 per cent. of carbonic acid. The ordinary purifiers will therefore have only 8 per cent. more sulphuretted hydrogen to remove (instead of 16 per cent., as stated by Mr. Greville); and 9 per cent. (instead of 25 per cent.) of carbonic acid. The additional sulphuretted hydrogen need not be considered, as the cost of removing it will be inappreciable; but the 9 per cent.—if this be the extra quantity—of carbonic acid left in the gas will add slightly to the cost of purification.

The superphosphate is, without exception, the best agent that has ever come within my experience for absolutely removing every trace of ammonia, and if, as the patentees expect, the ammonia removed in this way will realize a higher price, the process ought to come into general use.

George Livesey.

Exhibition of Gas Apparatus at Weston-super-Mare.

An exhibition of gas apparatus was recently held at Weston-super-Mare, England, under the auspices of the gas company of that place, of which company Mr. J. W. Helps is manager. There were 24 different firms represented at the exhibition, including among the number Messrs. Sugg & Co., Bray & Co., John Wright & Co., and S. Leoni. The Otto and Bischoff gas engines were also among the exhibits.

In all respects the display was a complete success, and much interest was evinced by the townspeople as to the working of the various apparatus. Mr. J. W. Helps, the manager of the gas company, made some introductory remarks at the opening. He spoke as follows:

Naturally, the directors were looking to their own interests in taking the step, but he thought he could show that the inhabitants of the town generally had it in their power greatly to further their interests by a visit to the Hall, if they would but cast aside preconceived prejudices and judge for themselves by what they could see, feel, and taste while there. Referring to the cooking, Mr. Helps said he thought there were two special reasons why this mode of preparing food is not generally adopted. First, its supposed greater expense. He said "supposed," because in his own mind he was certain that it was quite a fallacy, and he spoke with some amount of experience, having been brought up as one of a large family in a house where all the cooking was done with gas as far back as he could remember, and having also spent a considerable time in the North of England in fairly testing the comparative merits of the rivals, coal and gas; and, all things considered, he never yet found an instance where gas came off second best.

He did not pretend to be a cook, and would not care to undertake the cooking of a plain dinner by means of a kitchen fire; at the same time, he should have no fear in promising to place on the table a well-cooked leg of mutton and vegetables if he were allowed the use of a good gas stove. However, he could promise, with gas at its present price in this town, that the cost of cooking would be less than one penny. But the saving did not end here. Supposing he took two pieces of mutton weighing ten pounds each, and cooked one in a gas stove and the other before an ordinary fire. The piece after being cooked by the former means would have lost about 1 lb., whilst the fire would have exhausted from the meat not less than 2 lbs. at least. Here, then, would have been a saving of at least 1s. 3d., a fair price per pound for cooked meat.

The second objection brought against gas cooking was the idea that meat so prepared must of necessity taste of the gas. Actual experience utterly

disproved this statement. Most of the hotels, restaurants, hospitals, etc., especially in the north, had adopted this mode of cooking, and he was sure that if this objection had any real foundation, there would be plenty of people who would have discovered it, and who would not have been long in publishing it. But although he had heard many people, who had perhaps to their own knowledge never tasted meat cooked by gas, assert that it must have a disagreeable taste, he had no recollection of hearing anyone who had had a meal of food thus prepared ever venture a similar objection. On the contrary, they had been found to confess that the cooking was equal, if not superior, to that which they had been accustomed to. He only asked them to give it a fair trial, and he was confident that they would never again advance this reason for not using gas.

These were the two principal reasons generally considered as fatal, and having disposed of these, he trusted, to the satisfaction of his hearers, he asked them to think of the comfort to be derived by the substitution, especially in summer, of gas for coal as a cooking agent. They would thus avoid the great heat given off from a roaring fire, the comfort of the cook thereby greatly increased; indeed, they could be almost independent of that useful member of the household, for they need to have but a very slight acquaintance with the rudiments of cooking to be able, with a gas stove, to produce a plain dinner as well as a person brought up to the culinary profession.

But the advantages of gas did not end with cooking. The various appliances exhibited showed how easily adaptable for other purposes is the same coal gas—for heating rooms, halls, conservatories, far more effectively and cheaply than by any other means.

Again, they had but to watch one of the gas engines at work to note how much time, expense, and labor are saved and convenience obtained by the use of such a machine. There is no steam to raise, no fire to keep burning—all they had to do was to turn a tap and light a small jet, and little or no attention was afterward required to keep it going.

Mr. Helps then proceeded to show to what an extent people had it in their own hands to have their rooms either well or badly illuminated with an equal expenditure of gas. It might scarcely be credible how widely the illuminating power of gas might be varied by burning it through different burners. Take the Weston gas and test it by the photometer when burning through the new standard Argand burner, as made by Mr. Sugg, and it would be found to give, at five feet per hour, a light equal to nearly 19 candles; tried through another burner, it produced a light equal to about 15 candles; and merely by changing the burner, and consuming the same five feet per hour, he could reduce the illuminating power of the gas from 16 to 5 or 6 candle power. He was convinced that eight out of every ten complaints received about the quality of the gas had their origin in the use of bad or worn out burners. If householders would but look into this matter and get a fitter to supply them with suitable burners, less complaint, he was persuaded, would be heard of bad gas. If, too, they would but see the decided economy and other advantages to be derived from its use, for purposes other than lighting, they would then quickly have its price considerably reduced, and the much abused, but really indispensable and unrivalled agent need have no fear of being eclipsed by the newer, and at present much talked of and more fashionable system of electricity.

Beyond the actual advantages to be derived from the use of coal gas in its varied forms, he asked visitors to the exhibition to pay a little attention to other exhibits, which might appear at first sight somewhat outside its immediate object, but which would, if they did nothing else, at any rate enlarge one's ideas on the subject of distillation of coal gas. Let them give more than a passing thought to the wonderful industries opened out by the recent labors of distinguished chemists. The results of those researches were seen in the beautiful dyes and other products from coal tar and ammoniacal liquor. It was not so very many years since when both these were considered almost, if not quite useless, and being treated as nuisances were got rid of anyhow. But one by one the various substances now obtained from them were discovered, and now the yearly revenue derived from their sale goes a long way toward paying for the coal itself.

He believed the starting point of these discoveries was the production in 1858 by Perkins—though it is said that Prof. Faraday made the discovery some thirty years earlier—of benzoline from coal tar. It is from this substance that so many of the beautiful dyes are made. About twenty-three years ago two German chemists discovered that the coloring matter in the madder plant, which yields the Turkey red so much used in dyeing carpets, was similar to the alizarine which is obtained from anthracine, one of the hydrocarbons contained in coal tar. For this madder plant we used to pay France and Holland over a million sterling a year. From this same substance may also be obtained a deep violet, and the Scriptural color, Tyrian purple.

Besides these beautiful dyes many well-known scents, such as the essence of bitter almonds, so much used in scenting soaps, are obtained. Indeed, knowing that coal has been formed from the decomposition of the flowers and vegetables of a remote age, the consideration of this subject seems to prove the saying that "nothing is ever lost," for now, after the lapse of thousands of years, we have here reproduced the same lovely colors and odors which made beautiful the flora of a bygone age, and also explains the well-known remark of the great engineer George Stephenson, that coal was only "the rays of the sun bottled up."

Cheap Gas for Gas Motors.

By J. Emerson Dowson.

In many countries, and for many years past, inventors have sought some cheap and easy means of decomposing steam in the presence of incandescent carbon, in order to produce a cheap heating gas. It would serve no useful purpose here to describe all that has been done in this direction, but it may be stated briefly that the early attempts consisted in passing steam through iron retorts heated by external fires. This not only involved a large cost for firing, but also the rapid destruction of the retorts, as much of the oxygen from the steam combined with the red-hot iron. Later, external fires were dispensed with, and the steam was passed through a column of fuel previously rendered incandescent by an air blast. For a few minutes the steam was rapidly decomposed, but at the expense of much heat withdrawn from the fire, and soon it was necessary to shut off the steam and again introduce the air blast. Thus the working was intermittent, and the quality of the gas produced varied greatly.

Dr. Siemens and others have made gas for furnace work by means of passing air only, or air with a small admixture of steam, through a mass of burning fuel, and when the gas thus made and the air required for its combustion are superheated by means of the outgoing products, very excellent results have been obtained. Such gas, however, contains too much nitrogen (60 to 70 per cent.) to be suitable for gas engines and other purposes requiring it to be used in small quantities, and the plant is large and costly.

Following somewhat in this direction, the writer has devised an apparatus which is small in size and easy to work, and which gives a stronger gas of uniform quality. This apparatus has been fitted up on a full size scale in the garden of the Industrial Exhibition, and is there making gas for a 3½ horse power Otto engine, so that a detailed description of it here will not be necessary. Suffice it to say that the retort or generator consists of a vertical cylindrical iron casing, which encloses a thick lining of ganister, as in a foundry cupola, to prevent loss of heat and oxidation of the metal; and at the bottom of the cylinder is a grate on which a fire is built up. Under the grate is a chamber, and a jet of superheated steam plays into this and carries with it, by induction, a continuous current of air. The pressure of the steam forces the mixture of steam and air upward through the fire, so that the combustion of the fuel is maintained while a continuous current of steam is decomposed, and in this way the working of the generator is constant, and the gas is produced without fluctuations in quality. The well-known reactions occur—the steam is decomposed, and the oxygen from the steam and air combines with the carbon of the fuel to form carbon dioxide (CO_2), which is reduced to the monoxide (CO) on ascending the fuel column.

In this way the resulting gases form a mixture of hydrogen, carbon monoxide, and nitrogen, with a small percentage of carbon dioxide, which usually escapes without reduction. The steam should have a pressure of 1½ to 2 atmospheres, and is produced and is superheated in a zig-zag coil, fed with water from a town supply, from an overhead tank or from a pump with an accumulator; or, instead of water, it is better still to draw steam from a neighboring boiler, and to pass this steam into the coil to be superheated. The quantity of water required is very small, being only about seven pints for each 1,000 cubic feet of gas, and, except on the first occasion, when the apparatus is started, the coil is heated by some of the gas drawn from the holder; so that, after the gas is lighted under the coil, the superheater requires no attention.

For boiler and furnace work the gas can be used direct from the generator; but where uniformity of pressure is essential, as for gas engines, gas burners, etc., the gas should pass into a holder. The latter somewhat retards the production, but the steam injector causes gas to be made so rapidly that a holder is easily filled against a back pressure of 1 in. to 1½ in. of water, and at this pressure the generator can pass gas continuously into the holder, while, at the same time, it is being drawn off for consumption.

The nature of the fuel required depends on the purpose for which the gas is used. If for heating boilers, furnaces, etc., coke or any kind of coal may be used; but for gas engines, or any application requiring great cleanliness and freedom from sulphur and ammonia, it is best to use anthracite, as this does not yield condensible vapors and is free from impurities. Good qualities of this fuel contain over 90 per cent. of carbon and so little sulphur that for some purposes purification is not necessary. For gas engines, etc., it is, however, better to pass the gas through some hydrated oxide of iron to remove sulphuretted hydrogen. The oxide can be used over and over again

after exposure to the air, and the purifiying is thus effected without smell or appreciable expense. Gas made by this process and with anthracite coal has no tar and no ammonia, and the small percentage of carbon dioxide present does not sensibly affect the heating power. A further advantage of this gas is that it cannot burn with a smoky flame, and there is no deposition of soot, even when the object to be heated is placed over or in the flame, and this is of importance for the cylinders and valves of a gas engine.

To produce 1,000 cubic feet only 12 lbs. of anthracite is required, allowing 8 to 10 per cent. for impurities and waste. Thus, a generator A size, which produces 1,000 cubic feet per hour, needs only 12 lbs. in that time, and this can be added once an hour or at longer intervals. No skilled labor is necessary, and in practice it is usual to employ a man who has other work to attend to near the generator, and to pay him a small addition to his usual wages.

The cost of making the gas depends to a certain extent on the size of the generator. The A size is 2 ft. diameter by 3 ft. 7 in. high, and is the smallest made for practical work. The B size is 2 ft. 2 in. diameter by 3 ft. 9 in. high; and the C size is 2 ft. 8 in. diameter by 4 ft. 3 in. high. A reliable statement of the actual cost of producing gas in these generators, based on long experience in several places, is given in the Tables I., II., and III.; and from these it will be seen that, allowing 1s. to 1s. 6d. a day for wages, the total cost of production per thousand cubic feet (including depreciation and interest on capital outlay) is 4¼d., 3⅜d., and 2¾d. for the A, B, and C generators respectively. The rates of production given in these tables are with a steam pressure of 25 lbs. per square inch, and with the gasholder weighted to give a pressure equal to 1 inch of water.

Approximately the composition of the gas thus made is as follows:

Hydrogen	20	per cent.	by volume.
Carbon monoxide, CO	30	"	"
Carbon dioxide CO_2	3	"	"
Oxygen	—	"	"
Nitrogen, etc	47	"	"
	100		

This gives about 50 per cent. by volume of combustible gases, and the calorific power of 100 liters is 155,836 gramme units of heat. Its calorific intensity is 2,268° C. (4114° F).

With this we may compare ordinary coal gas of the following average composition, as given by Dr. Frankland:

Hydrogen	51.81	per cent.	by volume.
Marsh gas, CH_4	35.25	"	"
Olefiant gas, C_2H_4	3.53	"	"
Carbon monoxide CO	8.95	"	"
Carbon dioxide CO_2	—	"	"
Nitrogen	0.38	"	"
Oxygen	0.08	"	"
	100.00		

This has a calorific power of 559,038 gramme units for 100 liters, and is therefore about 3.5 times greater than that of the Dowson gas. Its calorific intensity is 2,554° C. (4,629° F).

The comparative explosive force of the two gases, calculated in the usual way, is 3.4—that is, coal gas has 3.4 times more energy than the writer's gas. Messrs. Crossley, of Manchester, the makers of the Otto gas engines, have made several careful trials of this gas with some of their 3½-horse power (nominal) engines, and in one trial they took diagrams every half hour for three consecutive days. These practical trials have shown that, without altering the cylinder of the engine, it is possible to admit enough of the Dowson gas to give the same power as with ordinary coal gas. It has been seen that the comparative explosive force of the two gases is as 3.4 to 1, but, as is well known, the combustion of carbon monoxide proceeds at a comparatively slow rate, and for this reason and because of the diluents present in the cylinder, which affect the weaker gas more than coal gas, experience has shown that it is best to allow 5 volumes of the Dowson gas for 1 volume of coal gas, and then the same uniform power is obtained as with the latter.

This gives very important economical results, for if the cost of the Dowson gas, given in the tables as 4¼d., 3⅜d., and 2¾d. per 1,000 cubic feet, be multiplied by 5, there will be 1s. 9¼d., 1s. 4⅞d., and 1s. 2¾d., or a mean of about 1s. 5½d. for the equivalent of 1,000 cubic feet of coal gas, which usually costs from 3s. to 4s.; and this represents and actual saving of about 50 to 60 per cent. in working cost.

Another practical consideration is that coal gas requires 224 to 250 lbs. of coal per 1,000 cubic feet of gas, but the writer's requires only 12 lbs. per 1,000 cubic feet; and multiplying this by 5, to give the equivalent of 1,000 cubic feet of coal gas, for engine work, there are 60 lbs., instead of 224 to 250 lbs. This is only 24 to 27 per cent. of the weight of the coal required for coal gas, and in many outlying districts this will effect an appreciable saving in the cost of transport.

A further point of great interest is that the results obtained with this gas and a small Otto engine have proved that one-horse power (indicated) per hour is obtained with a consumption of gas derived from 1.46 lbs. of coal, after allowing 10 per cent for impurities and waste of the latter. The calculations for this are as follows:

With a 3½-horse power (nominal) engine the consumption of coal gas is 22 cubic feet per indicated horse power per hour, and, multiplying the 22 cubic feet by 5 for the Dowson gas, we have 110 cubic feet; and as 900 cubic feet effective of the latter gas are produced from 12 lbs. of coal (after allowing for the gas used for the superheater), we have

$$\frac{110 \times 12}{900} = 1.46$$

With engines of larger power the loss due to friction is proportionally less, and the consumption of gas per indicated horse power is less. Thus, with a 16-horse power (nominal) engine, which can indicate up to about 40-horse power, the coal gas consumed is 18 cubic feet per indicated horse power, and, multiplying this by 5 for the Dowson gas, we have 90 cubic feet, which gives a consumption of only 1.2 lbs. per indicated horse power per hour—

$$\frac{90 \times 12}{900} = 1.2.$$

Mr. F. C. Marshall, in a carefully prepared paper, recently read before the Inst. M.E., gives the consumption of coal for 39 steamships with compound engines in long sea voyages, and indicating an average of 1,450-horse power each; and this gives an average of a very small fraction under 2 lbs. per indicated horse power per hour. This result is not nearly attained with land engines of moderate size and of the usual type, and in a recent competition of portable engines of the best class the fuel consumption was over 4 lbs. per indicated horse power per hour. They were then working under the most favorable conditions at a prize meeting, and it may be assumed that 6 lbs. to 8 lbs. more nearly represents their usual fuel consumption, especially after the boilers have been used a few months.

It will thus be seen that by using the writer's gas a small gas engine can compete favorably in fuel consumption with the largest and best steam engines, and that a very great saving can be effected when compared with steam engines of moderate size and of the usual type.

A practical illustration of the relative working cost of an ordinary steam engine, a gas engine driven with coal gas, and a gas engine driven with Dowson gas (in each case indicating 30-horse power effective), will be found in Table IV. This shows that a gas engine driven with Dowson gas costs about 45½ per cent. less than with coal gas at 3s. per 1,000 cubic feet, and about 47½ per cent. less than a steam engine. The most striking feature, however, is that, with a steam engine consuming 6 lbs. of coal per indicated horse power per hour, and without adding any allowance for fuel used in getting up steam and after work is done, 217 tons of coal are required to give the same power as 39 tons of coal converted into gas by the writer's process and afterward used in a gas engine. This represents an actual saving in fuel of 88 per cent.

The writer will not detain the meeting longer with particulars of the other purposes for which his gas is being used, but he will add a few words as to its calorific power for heating generally. It has been seen that for special reasons it is best to allow 5 volumes of his gas for 1 of ordinary coal gas when worked with an Otto engine, but in all applications of the gas to heating purposes experience has shown that about 3.5 volumes of this gas are equal to 1 volume of coal gas. If, therefore, the cost of production given in Tables I., II., and III. be multiplied by 3.5 there will be 1s. 2¾d., 11⅞d., and 9¾d., or a mean of 1s. as the total cost of the proved equivalent of 1,000 cubic feet of coal gas for heating purposes. This statement is based on the practical working of 16 generators, of which two have been in use over two years at a large country house in Montgomeryshire belonging to Lord Sudeley.

APPENDIX.

Table I.

Generator A size (producing 1,000 cubic feet per hour).

	s.	d.
Anthracite to make gas at the rate of 1,000 cubic feet per hour = 12 lbs. × 9 working hours = 108 lbs., or, say, 1 cwt. at 20s. per ton	1	0
Allowance for wages of attendant	1	0
Repairs and depreciation of generator, gasholder, etc., (5 per cent. on £125) = per working day	0	5
Interest on capital outlay	0	5
Total	2	10

Gas produced	9,000	cubic feet.
Less gas used for generating and superheating steam	1,000	"
Total effective gas for 2s. 10d.	8,000	"

Net cost, 4½d. per 1,000 cubic feet.

Table II.

Generator B size (producing 1,500 cubic feet per hour).

	s.	d.
Anthracite to make gas at the rate of 1,500 cubic feet per hour = 18 lbs. × 9 working hours = 162 lbs., or, say, 1½ cwt. at 20s. a ton	1	6
Allowance for wages of attendant	1	0
Repairs and depreciation of generator, gasholder, etc., (5 per cent. on £140) = per working day	0	5½
Interest on capital outlay, ditto, ditto	0	5½
Total	3	5

Gas produced	13,500	cubic feet.
Less gas used for generating and superheating steam	1,200	"
Total effective gas for 3s. 5d.	12,300	"

Net cost, 3½d. per 1,000 cubic feet.

Table III.

Generator C size (producing 2,500 cubic feet per hour).

	s.	d.
Anthracite to make gas at the rate of 2,500 cubic feet per hour = 30 lbs. × 9 working hours = 270 lbs. at 20s. per ton	2	4½
Allowance for wages of attendant	1	6
Repairs and depreciation of generator, gasholder, etc., (5 per cent. on £160) = per working day	0	6½
Interest on capital account, ditto, ditto	0	6½
Total	4	11½

Gas produced	22,500	cubic feet.
Less gas used for generating and superheating steam	1,500	"
Total effective gas for 4s. 11½d.	21,000	"

Net cost, say, 2¼d. per 1,000 cubic feet.

Table IV.

Comparative working cost of engines indicating 30-horse power for 300 working days of 9 hours each.

(*a.*)—*Steam Engine.*

The coal required = 6 lbs. per indicated horse power, exclusive of coal burnt in getting up steam and after work is done. The following is the working cost:

	£	s.	d.
Coal = 30 × 6 × 2700 = say 217 tons + allowance of 10 tons for coal consumed before and after working = 227 tons, at 15s.	170	5	0
Water for engine at 3 gals. per indicated horse power per hour = 3 × 30 × 2700 = 243,000 + allowance for blowing off, etc., say 250,000 at 6d. per 1,000 gals.	6	5	0
Oil for engine, 3d. per day × 300	3	15	0
Wages of fireman, at 3s. 6d. × 300	52	10	0
Repairs and depreciation of boiler and engine (10 per cent. on £360)	36	0	0
Interest on capital outlay (5 per cent. on £360)	18	0	0
	£286	15	0

(*b.*)—*Gas Engine* (*worked with coal gas*).

	£	s.	d.
The consumption of gas for this sized engine = 18 cubic feet per indicated horse power per hour ∴ total gas required for 30-horse power for 2700 hours = 30 × 18 × 2700 = 1,458,000 cubic feet at 3s. per 1,000 cubic feet	218	14	0
Oil for engine, 4d. a day × 300	5	0	0
Wages for superintendence of engine, cleaning, etc., say 1s. a day × 300	15	0	0
Repairs and depreciation of engine (5 per cent. on £370)	18	10	0
Interest on capital outlay, ditto	18	10	0
	£275	14	0

(*c.*)—*Gas Engine* (*worked with Dowson gas*).

With an Otto engine, 5 volumes of Dowson gas give the same power as 1 volume of coal gas; ∴ total Dowson gas required = 30 × 18 × 5 × 2700 = 7,290,000 cubic feet. The following is the cost of working:

	£	s.	d.
Anthracite to make 7,290,000 cubic feet of gas (at 12 lbs. per 1,000 cubic feet, including 10 per cent. for impurities and waste) = 7290 × 12 = say 39 tons, at 20s.	39	0	0
Oil for engine, 4d. a day × 300	5	0	0
Wages for fireman, at 3s. 6d. × 300	52	10	0
Repairs and depreciation of engine (5 per cent. £370); and of generator, holder, etc., (5 per cent. on £140)	27	0	0
Interest on capital outlay	27	0	0
	£150	10	0

Economy in working cost in favor of Dowson gas compared with steam	say, 47½ per cent.
Ditto, ditto, compared with coal gas at 3s. per 1,000 cubic feet	" 45½ "
Saving in weight of coal in favor of Dowson gas and gas engine, compared with steam engine requiring 6 lbs. of coal per indicated horse power, is as 217 is to 39 tons	" 88 "

NOTE.—The price of coal varies in different localities, but the above will serve as a basis for comparison. The full wages of the fireman are charged, but in the case of the generator it is not necessary for him to give more than about half his time.—*Review of Gas and Water Engineering.*

Preparation of Pure Naphthaline.

By G. LUNGE.

Tha manufacture of pure naphthaline on a large scale and at a cheap rate is still considered a secret process, and is not known to many tar distillers. Hence, I may hope, that a communication of a convenient process for this purpose may be welcome to many of your readers, and I am fully entitled to publish it, as I have found it quite independently, and as I am, indeed, not even aware whether the same, or a similar plan, is in use at those tar-works where pure naphthaline is prepared.

Everybody knows that even very white naphthaline turns pink in the air after some time; this tendency can be overcome only by repeated crystallizations, washings, distillations, etc. Now the manufacturers of naphthol require naphthaline as nearly as possible chemically pure, and regard as a principal criterion its keeping permanently white. On the other hand, so much and so cheap pure naphthaline, made by "secret processes," is in the market that evidently no purifying process has any chance which is not very simple and inexpensive. When working at a treatise (now in the press) on coal tar and ammonia, my attention was necessarily drawn to the above gap in our public knowledge, and it became my task to try filling it up, in which I succeeded very soon.

I started from the assumption that the discoloration of naphthaline is analogous to that of phenol, and that it may be caused by the difficulty of removing the last traces of phenol from naphthaline. Now, perfectly pure phenol does not discolor, but it does so when containing traces of higher homologues, and when exposed to the air. The presence of traces of mineral acids seems to be another condition for the development of the pink color. It may be that the latter influence causes the formation of aurin, thus:

$$2C_6H_6O+C_7H_8O+3O=3H_2O+C_{19}H_{14}O_3:$$

but it is immaterial whether this or any other pink compound is formed. In any case it seemed possible to form at once, by previous oxidation, the substance which causes the gradual discoloration of phenol, or of naphthaline, and to separate it, if not volatile, by distillation so as to obtain permanently white products.

Starting from this idea, I tried the addition of an oxidising agent in the ordinary chemical washing of naphthaline, and I succeeded at once. Crude naphthaline is usually obtained from tar oils previously treated with an alkali for the purpose of extracting the phenols, and in this case evidently the action of acids should commence the purifying operations; but if naphthaline obtained direct from tar were to be treated, the first operation should be washing with alkali. The crude naphthaline is fused with a certain quantity of sulphuric acid. Acid of 170° Tw. is best, and of this from 5 to 10 per cent. will be required on the larger scale, but even acid of 140° Tw., employed in a little larger quantity, will do very well. When the liquid naphthaline and the vitriol have been well mixed up together, 5 per cent. of the weight of naphthaline of manganese dioxide is gradually added. Native manganese, well ground up, may be used, but recovered manganese (dried Weldon mud) is preferable. The mixture is heated on the water bath till no further reaction takes place, say for 15 to 20 minutes. The acid is now drawn off, the naphthaline washed several times with weak caustic soda solution, and again with water. It proved unnecessary to repeat the acid treatment, or to employ strong alkali.

Evidently manganese dioxide may be replaced by any other oxidising agent, but I did not make any experiments thereon, as there was no hope of finding a cheaper agent. Even a current of air would not be much cheaper, but it would be hardly as efficient, and would carry away a good deal of naphthaline.

The naphthaline cake is now distilled, and nearly all can be collected within one or two degrees of the boiling point of pure naphthaline. The

distillation should be carried on on the small scale in a long-necked flask; on the large scale in a still provided with a dephlegmating column.

A sample of naphthaline prepared by me according to the above simple and cheap plan has already kept its pure white color for eight or nine months, whilst all the samples of "chemically pure" naphthaline which I had obtained from the most celebrated manufacturers, and which were kept in the same glass case, have long since turned pink.—*Chem. News.*

The Consumption of Fire Damp.

At the Frankfort Patent and Trade Mark Exhibition there was shown a most ingenious apparatus for consuming fire-damp by chemical means which deserves the attention of our mining engineers.

Hitherto only physical means have been adopted, but the principle of the Körner apparatus consists in using the decomposing properties of platinum metals in annihilating fire-damp. The inventor is Herr Guido Körner of Freiberg, Saxony, and the maker, Herr L. Frobeen, of Berlin. The invention is described as "an apparatus for consuming fire-damp," and consists of a so-called "ligroin lamp," over the burners of which asbestos caps coated with platinum and palladium are fixed. These caps are heated up to a red heat, and the apparatus brought into the mine and hung up in places where fire-damp exists. The caps are never heated up to white heat; thus any danger of fire-damp igniting on them is out of the question, even if the gases should occur suddenly in large quantities. The apparatus may therefore be safely used wherever fire-damp or an accumulation of explodable gases exists.

It operates always quietly, without detonation, the fire-damp being consumed on the surface of the glowing caps, without heating them to any extent, and annihilates the considerable quantity of 35 to 53 cubic feet of explodable fire-damp per minute, or 53,000 to 70,000 cubic feet in the twenty-four hours. The basin containing the oil is filled every twenty-four hours, the apparatus requiring no further attention during that time. Extensive experiments are to be carried on with the apparatus at the mines of Hermsdorf, Germany, and it is to be hoped that after its trial we may be able to say that it is of practical value, and that thus a boon will be conferred upon our colliers in affording them greater protection in their laborious calling, carried on at considerable peril to life and limb.—*Iron.*

Pollution of Sources of Water Supply to Cities.

Residents of New York city who visited Cincinnati on the occasion of the meeting of the American Association for the Advancement of Science, doubtless returned with a better appreciation of the water supply of their own city.

Cincinnati draws its supply of water direct from the Ohio river, at a point within the city limits, and within a few yards of the outlet of a main sewer which discharges its abominations into the already discolored and muddy waters of the river.

Some idea may be formed of the condition of this water, when we state that a small quantity poured into a washing basin obscured the view of the bottom of the utensil, so opaque is the water by reason of its muddy impurity. And yet, the river at this time was at its best, for, undisturbed by rains or floods, it flowed past the city reduced to its lowest limits, and in its highest condition of purity.

Unanimity among the population of a large city on any one point is not to be expected, but it was with some surprise we heard expressions of admiration regarding this water from some Cincinnatians. The majority of the people, however, were disgusted with the water supply of the city, and many were seeking their own remedy by the construction of artesian wells. The public press of Cincinnati, during our visit, was loud in its denunciations of the evil, making excellent suggestions for obtaining the water supply from a purer source, and other needed improvements.

Recently the question has been much discussed as to whether a city should draw its supply from a river, or from lakes and storage reservoirs. Which will give the best results?

This question is beset with many difficulties, and, in our opinion, cannot be determined in such a manner that any particular decision for future guidance, *in all cases*, can be delivered. We apprehend that local causes and conditions, which vary for every locality, having due weight and being well considered, should decide the question.

Of course, absolute purity is not demanded, neither is it essential. The object to be aimed at, and that must be secured at any cost, is such a condition of purity which may be expressed by the term "fitness."

A water that is free from any impurities dangerous to health, of a good color, and inodorous, may be considered "fit" for the supply of a city.

The question as to the best source for a supply of water has of late received much attention from chemists and sanitary engineers. Reviewing the discussions, we express the opinion that water drawn from a river which is free from sewage contaminations, and not subject to discoloration, is preferable to water collected in lakes and storage reservoirs. The storage of water in reservoirs for long periods without doubt causes a deterioration in the quality of the water, generating a variety of animal and vegetable forms that are characteristic of stagnant waters, and which are dangerous to health. River water, on the contrary, if not contaminated directly near the source of supply, is usually free from those impurities which are most undesirable.

On this point we refer our readers to *Science*, Volume I., page 67, where will be found an analysis of the water supply of Newark, N. J., obtained from the river Passaic, contrasted with water used in that city obtained from driven wells. The result showed that the water from the Passaic river, although contaminated with sewage to a certain extent, and below what may be considered a satisfactory condition, stood at the head of the list in regard to purity and general fitness for sanitary purposes. We believe that recently Professor Leeds, of Hoboken, has made analyses of the same waters, with very similar results.

But, from whatever source water may be obtained, a certain amount of manipulation appears to be essential before it is fit for distribution in a city. In the first place it should be held in a reservoir for 24 hours, to permit the suspended matter to subside; it should go through some simple process of filtration; and, lastly, be pumped to a sufficient elevation to secure a supply of water to the upper part of every house in the city.

The question of the public filtration of water for city use no doubt presents many difficulties, but until such filtration is accomplished by the authorities, every householder should make use of a filter, to cleanse from impurities, the water used for drinking and cooking purposes; for apart from the question of health, the interest of the public in securing pure water is not confined to its use as an article of diet, because for all purposes for which water is employed, the purer it is, the better it is adapted for use.—*Science.*

The Coal Fields of South Africa.

The "Report on the Geology of Karoo and Stromberg (Cape Colony)," by Mr. William Molyneux, F.G.S., has just been presented to both Houses of the Colonial Parliament, and contains much valuable information. He states that there was not one of the many owners and tenants of land he saw and conversed with in the Karoo and Nieuwveldt that did not ask him if he could tell how and from whence more water could be got. Coal was in every case secondary to water, and the necessity there is for a more abundant and reliable supply of water for purely agricultural purposes was too well illustrated in the sometimes deserted, always but half-cultivated condition, of every farm over which he passed

There are, he considers, numerous stores of water hidden away beneath the surface of the Karoo which only require tapping and applying to the cultivation of the land to bring about a greatly improved condition of things—a condition of things that could not but be highly beneficial to the colony at large, as it would increase the production of grain and food, and by that means further the advent of the day that is to see the colony more self-supporting, and, in this respect, more independent of outside help than it is.

Mr. Molyneux has not been successful in finding coal in the Karoo, and reports that it does not exist there. He, therefore, devotes himself to explaining why it is absent from rocks occupying so considerable an area of South Africa, and which, moreover, had been long known to contain remains of a vegetation supposed, and even held to be, at least in part, identical with the carboniferous flora of Great Britain. These hypotheses, not being of any direct commercial value, may be passed over. It appears that, although lepidodendron, calamites, glossopteris, etc., are often found in coal, the finding of them elsewhere does not necessarily indicate the presence of coal in their neighborhood. The removal of soil from the rock surfaces in these districts is a remarkable circumstance. Mr. Molyneux mentions that the long absence of rain prevents the growth of grass, and he has seen as many as fifteen whirlwinds at one time in the Karoo, all charged with columns of dust—the Karoo soil.

The deposits of which the Nieuwveldt and Camdeboo beds are composed consist of a similar variety of sandstones, shales, marls, and occasionally limestones, with constantly recurring beds and dykes of greenstones. They, in general, are not so hard or crystalline as the Karoo beds. The sandstones are somewhat more coarse. Three deposits of coal have been examined. Those at Nieuwveldt and Camdeboo, 150 miles apart, are each at 4,200 feet above sea, and there is a third deposit 3,500 feet above sea level. The coal is, in each case, a beautiful bright and pure anthracite, and is at both places contained in fissures in the sandstones and marls through which these fissures happen to pass—the fissure to occupy a space about 15 feet vertical, and the maximum thickness is 2 feet three inches. It is in the form of J, thinning out at top and bottom. There had been a considerable

quantity of coal extracted from one heading which Mr. Molyneux examined, and it was stored in bags on some premises near. It consisted in the main of cubical lumps from about the size of a walnut to that of an orange; was rather heavy, but peculiarly bright, lustrous, and, he adds, unnaturally so. Mr. Molyneux considers the extent of the Stromberg beds does not exceed 3000 feet. Their important feature is that they contain seams of coal.

There are several of these seams, varying from one inch to two feet and upwards in thickness. The beds occur singly and in groups, varying from three to twelve in number, and divided from each other by bands of shale or clay, varying from one inch to over one foot in thickness. They are, in the aggregate, seams made up of coal that is of a workable thickness, and answering all the requirements, in this respect, of coals to be commercially and economically valuable.—London *Mining Journal.*

The Petroleum Outlook.

The amount of crude production for the month of August has been the theme of discussion in the producing regions to a greater extent and more generally participated in by all classes interested in the trade than at any former period since it became an article of commerce. The immediate cause of the discussion was the August report of well stocks in the Bradford district, made by J. C. McMullen, compiler for the producers' committee and approved by them. According to the report the daily decrease in the wood tank stock at 7,739 wells was 30 1-10 barrels to the well; at the same ratio of decrease for all the wells in the district, say 10,700, the total decrease for the month would amount to 322,270 barrels. The report also shows a decrease in the private iron tanks of 44,299 barrels, which was afterwards corrected by adding 1,000 barrels per day for one tank included in August report, and not given in July report, making a decrease for the month as follows:

In wood tanks (whole district)	322,270 barrels.
In private iron tanks "	75,299 "
Total decrease for the month.....	397,569 barrels.

Take the above amount from the total stocks reported by the pipe lines at the close of the month, and the result would show an increase in production over the previous month; which result the trade almost unanimously do not accept and cannot reconcile the idea with the evident fact that nine-tenths of all the producers in the field claim that their wells produced less oil in August than the preceding month.

The difficulty experienced by the producers' committee in getting a correct report of the stock in the field has been to ascertain what iron tanks are connected with the pipe lines and what tanks are not connected with them. It is quite evident that errors have occurred in taking stock in iron tanks as private property, while the contents of the tank is included in the stock of the pipe lines and reported in their runs or receipts from all sources, while at the same time no visible connection between the lines and tanks are to be seen. We are making an effort, and probably will be successful, in ascertaining just what tanks have been taken in the lines during the month of September, which will enable us to ascertain with a greater degree of certainty the actual condition of stock in the field in our subsequent reports.

In ascertaining the decline of stock in the Bradford field we have added to the producers' committee's figures 36,731 barrels, having good reasons to believe that that amount at least has been duplicated.

The production for the month we find to be 2,233,727 barrels, averaging 75,217 barrels per day, which is 1,321 barrels per day less than in July. We anticipate a greater decline for the month of September, based on the pressure of gas in the wells, which is becoming weaker every month, and is especially noticeable in the Bradford district, where the operators are compelled to reduce the size of their tubing in order to retain the diminishing product of their wells as long as possible.

The shipments for the month out of the producing regions were enormously large and without a parallel, amounting to 2,214,877 barrels.

The drilling and completed wells for the month show a falling-off in number from the July report.

The aggregate production of the new wells on the last day of the month was 236 barrels less than in July.

The total stock of crude petroleum held in the producing regions July 31 was 24,888,337 barrels; the amount added in August was 116,850 barrels, making net stocks at the close of August, 25,005,187 barrels.

We have reliable information that from the stock of oil in the Bradford district, as it now stands, only about 55 per cent. of merchantable oil can be drawn from the tanks; the balance of 45 per cent. can be made to yield about 50 per cent. more, which will make the total yield about 77½ per cent. of merchantable oil.

Take from the total stock of about 25,000,000 barrels 22½ per cent., or 4,500,000 barrels from the Bradford district and it will reduce the visible supply to 20,000,000 barrels. With the above facts before us and this other fact that the stock is not likely to be increased in the near future together with the heavy export demand, and the increasing home consumption, we can but look upon the present price of crude as being below its real value, therefore a safe and profitable investment.—*Stowell's Petroleum Reporter*, Sept. 29.

Perils of theElectric Light Wires.

The Boston *Herald*, of October 2d, contains a lengthy account of the new dangers occasioned by the use of the electric current as an illuminator, from which we extract the following:

A few weeks ago the *Herald* called attention to the dangers to life and property consequent upon the existing and growing number of improperly constructed and improperly insulated wires used in conveying the force employed in generating the electric light. The incipient fires in the Paris electrical exhibition building then described have had several repetitions in this country, and several cases of loss of life and injury to limb have also been reported as the result of the dangers alluded to. Even Mr. Brush, the distinguished inventor of one of these brilliant illuminators, was seriously wounded a short time ago, and he probably reckons himself fortunate that he escaped with his life. He was showing some gentlemen the manner in which the modern light is manufactured, and by some careless move the powerful fluid took refuge on one of his thumbs, inflicting an ugly and painful wound, and laying the flesh bare to the bone. William J. Denver of Springfiefd, manager of the Western Union telegraph office in that city, also had an unpleasant experience a few evenings since. He was handling some fire-alarm wires in an engine house, and while thus engaged they became accidentally crossed outside with some electric light wires. The shock was so severe as to knock him down, and the wire which he was holding was reduced to molten iron in the fractional part of a second. If Mr. Denver had been so unfortunate as to have been in a position to allow the whole force of the escaped current from the illuminating wire to pass through his body, the telegraph company would have been deprived of a very efficient official, and the community would have mourned an esteemed member of society.

A man who came accidentally in contact with some of these dangerous illuminating conductors in Buffalo recently was instantly killed, and a member of the orchestra in one of the St. Petersburg theaters in Russia was also hurled to eternity in a twinkling by a similar mishap. There is a well authenticated case in Boston of where a telephone was burned up by the wire connected with it having become entangled or crossed with an electric light wire, but, fortunately, no conflagration ensued. The escape of the building from destruction, however, was not due to the inability of the electric current to give it a good start in that direction. This question of protecting the lives and property of the people from the danger described has very properly created a universal consideration of the matter since it was first agitated in the *Herald*. The insurance interest is not only looking into the matter, but even so distinguished a body as the National Association of Fire Engineers has urged immediate and effective legislation. At its meeting, just concluded at Richmond, Va., a special committee considered and reported upon the subject. "What Relation does Electricity Sustain to Quick Combustion?" was the language of the topic given the committee to investigate.

In its answer it admits that it was first at a loss to fully understand the significance of the question, and then went on to say: "Quick combustion may be so construed as to imply spontaneous combustion; and yet, in connection with electricity, such a construction seems out of place. Quick combustion may convey also the idea of speedy destruction of any given object by fire, and therefore we are induced by the duality of the proposition to treat the matter generally. Scientists classify electricity under several heads, viz., frictional, chemical, animal, etc. In considering the subject of electricity in connection with any form of combustion, we must of necessity ignore all forms of electrical currents save the most condensed and powerful. It has been time and time again demonstrated that lightning or atmospherical, frictional electricity, in seeking a lodging-place in mother earth, often becomes a dangerous incendiary, against whose ravages no adequate protection, as yet, has been satisfactorily devised The many disastrous fires in the oil regions of Pennsylvania during recent years have called out much learned public discussion, and, while men were devising means to ward off future attacks, the clouds proceeded tranquilly upon their way, and the thunderbolts descended with no respect to regularity or warning. The combustion of any object or ignitible material, when inflamed by a thunderbolt, is doubtless more rapid than would be the case under other circumstances of ignition, but probably no more rapid than combustion arising from some explosive agency, equally as destructive and instantaneous in action. Until recently the danger of sudden fires arising from chemical electricity, has been slight or entirely absent, because the volume of electricity required to transmit messages by motion or sound was and is entirely

indifferent as a fire-producing element. Danger from this source can only arise where combined and powerful currents are concentrated for the production of heat and light, and it is of the greatest importance that the conductors of such currents of electricity be thoroughly insulated, especially in connection with the electric light now coming into use in many cities and localities. Carelessness in this particular will some day demonstrate that powerful electrical action generated by chemical forces is as dangerous and disastrous as the thunderbolts of Heaven. The only logical and practical suggestions looking to protection against this fire producing element are found in the careful insulation of all objects to be protected, so far as human ingenuity can suggest such practical and thorough insulation, and disasters arising, notwithstanding such precaution, must be met and combatted with such skill and apparatus as the present places within our command."

Chief Engineer A. P. Leshure of Springfield, Mass., in urging a discussion of the question in the convention, said that the electric light is coming into use in many cities and he thought the firemen, as well as the public, should know whether they were calculated to endanger life and property. The fire marshal of New York reported that the cornice of a building had been set on fire at a point where it came in contact with an electric light wire, and ex-Chief Bennett stated that he knew of a fire occurring in Cleveland from a similar cause.

Joseph W. Stover, the well-known Boston electrician, was called upon, as an expert, to give his views upon the subject. He did so at length, and replied to many questions put to him by the members. The substance of his statement was that the large wires used for carrying a current of electricity sufficient for lighting purposes were dangerous to both life and property, unless thoroughly insulated; that, if one of the wires were broken, and a person grasped both ends of the wire, the current would pass through his body and kill him instantly; that the wires were charged so full of electricity, that the current was constantly seeking to escape from the wire and take the shortest route to the ground. If, in leaving the wire, it came in contact with an individual, it would be like a stroke of lightning; if with inflammable substances, a fire would be generated. He said that the principle of electric lighting was yet in its infancy, and he had no doubt the companies engaged in the business would, for their own protection, eventually find adequate means for insulating the wires.

Chief Swenie, of Chicago, told how a fire was caused in that city by the electricity leaving the wire where the insulation was broken, and, being attracted by a steel nail, set fire to the building. The discussion among the chief engineers was quite general, and at the close a special committee was appointed to consider a series of resolutions, and Mr. Stover was invited to retire with the committee and give it the benefit of his counsel. The resolutions reported by the committee were adopted, and were as follows:

"After hearing the report of the committee on topic No. Two, and the evidence adduced in the discussion following as to the danger of combustion and the liability of serious injury and probable death to any one coming in contact with improperly insulated or broken wires used for conducting electricity for lighting purposes, it is the opinion of this Association that, as the electric light is about to be introduced in many of our cities and towns, and without due precautions being taken in putting up the wires, and their introduction into buildings, they will become one of the worst and most dangerous factors in the already sufficiently difficult problem of 'unknown causes of fires,' and their extinguishment, that our fire departments have to contend with; therefore

"*Resolved*, That we, the National Association of Fire Engineers of the United States, urge upon the authorities of all cities and towns where the electric light is about to be introduced the absolute necessity of passing ordinances governing the manner in which all wires shall be strung for the purpose of producing the electric light.

"First—That the wires shall be distinct from all others.

"Second—That they shall be thoroughly insulated.

"Third—There shall be upon the exterior of all buildings where the wires are introduced an absolute cut-off (not a mere shunt), so that in case the firemen are called upon by cause of fire to enter there, the danger of instant death—the inevitable result of coming in contact with improperly insulated or broken wires under very many situations—may be in a very great measure avoided."

Mr. Stover, who has just returned from the Richmond convention, was interviewed by a *Herald* reporter yesterday on the subject under consideration. "In the production of any and all of the electric lights now in use," he remarked, "the currents used are of the most intense description. Large conductors of copper wire are used, but when the lights are burning these wires are so full of the subtle fluid that a portion of it will quit the lines upon the slightest provocation. The law of electricity is that it moves in the line of the least resistance, and so long as the conductors are large enough, and their continuity maintained, there is no danger; but let the current be increased beyond the carrying capacity of the conductor, or an obstruction or extraordinary resistance to its free passage occur, and there is instantly a disposition on the part of the fluid to jump the track. A case is reported in Chicago where a building was fired by a copper wire supplying an electric light, coming in contact or near the head of a nail. Separate the conductor for an electric light, and sparks will run from one end to the other of the severed wire through a space of at least half an inch, and if any combustible article were near, of course it would take fire. Let any one pick up those wires, and he would be hurried into eternity with no time to say a prayer. It is undeniable that, as now used, there is considerable danger to both life and property in the electric light. Men have been killed and property destroyed by the electricity used. The companies engaged in the business should recognize the danger involved, and provide against it. All wires should be carefully insulated; every inch should be covered; they should be colored, or so marked that every one would soon know them at sight, especially the firemen, who are liable to find them in burning buildings, and, at the point of entrance to buildings, the wires should be provided with "cut outs," so the current could be entirely shut off, just as water or gas may be, in case of necessity."

Gas Explosion in New York City.

Illuminating gas, which had escaped from a fractured service pipe in front of 711 Fifth avenue, the residence of Mr. Henry J. Goodwin, exploded at a quarter past one o'clock yesterday morning, alarming the residents of the neighborhood and damaging the street pavement and sidewalk. Two slight explosions at the same place occurred later—one at six A.M. and the other at nine o'clock. The Municipal Gas Light Company, to which the broken and dangerous pipe belonged, sent a gang of men to search for the leak. It was while they were at work that the last explosion took place, and John Foley, one of the laborers, was thrown violently to the ground by the shock. The leak was subsequently discovered to be at a joint in the service pipe, which is an inch and a half in diameter, and about three feet from the main. It was promptly repaired, and an investigation as to the cause of the break was begun.

In July last the street was dug up and a sewer built. The earth was hastily replaced, and as it was not sufficiently packed it afterward sank, allowing no support to the service pipe, and the weight of the pavement bearing on it caused the fracture. The escaping gas traveled through the crevices formed by the loose earth underneath the pavement and sidewalk on Fifth avenue from Fifty-fifth to Fifty-sixth street and the north side of Fifty-fifth street, percolating the interstices of the area walls into the cellars. The odor of escaping gas has been strongly felt in the cellar of St. Luke's Hospital, Dr. John Hall's Fifth Avenue Presbyterian Church, Mr. Louis L. Lorillard's mansion at No. 1 East Fifty-fifth street, and the Vanderbilt mansions, since the 22d of August, when an unaccountable explosion shook that section of the city. It is supposed that the leaking gas became ignited from a jet in one of the basements. The shock was felt from Fifty-first to Fifty-ninth street, and Fourth to Sixth avenue, and the residence of Mr. Goodwin vibrated as a sheet of flame shot up from the displaced pavement. The occupants of the freestone block were more or less startled. The damage is not considerable.—N. Y. *Herald*, Sept. 30.

[It would seem that gas companies have no rights whatever in the city of New York. The great majority of people who will have hastily read this account in the *Herald* will no doubt charge the occurrence of this accident to either the negligence or carelessness of the gas company. It is very unreasonable and very unjust to require the Municipal Company to bear the expense and loss attendant upon the search for this fracture. It is stated that the loss in this case is not considerable; but suppose that the broken service had been much larger, and the opportunity for damage greater, or that there might possibly have been loss of human life—what a howl of virtuous indignation would have been raised against the supposed offending gas company; and all because some ignoramus of a sewer builder had failed to properly perform the completion of his work.—Ed.]

Electric Light Towers in Denver.

The Denver *Republican*, of Thursday, September 29th, says the electric light towers in that city might as well be torn down. They are useless, utterly useless. The same paper, of date of October 1st, states that "the electric lights from the four towers, which are supposed to furnish sufficient light for the city, send forth their sickly glares every alternate night, or whenever the company seems disposed. In their present condition they are an intolerable nuisance. Forty similar concerns will not light the city. Unless they are improved the City Council will, of course, not sign their stipulated contract with the electric company, which provides that the city pay them $14,000 per year, in case the light proves efficient and satisfactory."

The Boston Meeting.

Captain Wm. Henry White, Secretary of the American Gas Light Association, has informed us that one of the features of the coming meeting at Boston will be a lecture on "Residual Products," by Mr. Geo. Shepard Page, of New York city.

It is needless to say that no other gentleman in this country is better qualified to speak on this subject than Mr. Page. He proposes to discuss the topic in all its bearings, and promises to bring to light some new features discovered by him during his recent visit to Europe.

Crystal Palace District Gas Company.

To the courtesy of Magnus Ohren, A.I.C.E., Secretary of the Crystal Palace District Gas Company, we are indebted for the receipt of the Report and Balance Sheet for the last half-year's working of this company. The following are the principal features :

The directors report that the general working of the company has been satisfactory for the half-year.

The reports of the gas examiners of the parishes supplied by the company, as to the illuminating power of the gas, its freedom from sulphuretted hydrogen and ammonia, and the limitation of the sulphur to the amount prescribed by the Parliamentary standard, continue to be satisfactory.

A contract has been made for a new gasholder, to be erected in the spring of next year. The tank to receive the holder is nearly completed. This gasholder will give the company an additional storage of 1,600,000 cubic feet of gas.

The directors recommend that an addition of £50 per annum be made to the salary of the Secretary.

The directors recommend the declaration of a dividend for the last half year ending the 30th of June last at the following rates per annum, viz.—6 per cent. on the preference stock ; 7 per cent. on the ordinary 7 per cent. stock : 10 per cent. on the ordinary 10 per cent. stock ; and 7 per cent. on the new ordinary 7 per cent. shares ; all less income tax. This will amount to £11,095 6s. 3d., and the sum of £3904 5s. 9d. will be carried forward to the profit of the succeeding half-year.

The chairman observed that the directors had much satisfaction in presenting the shareholders with a report which was in every way favorable. There was scarcely any incident about it which called for explanation from the chair. The only point in which a certain degree of vitality appeared to exist was in the paragraph which related to the contract for a new gasholder, of which the tank was now in progress, and which was intended to contain upwards of 1¼ millions cubic feet of gas. He was sure that the shareholders would accept this as a satisfactory evidence in connection with the company's business, as showing that the directors felt the necessity of preparing for a larger consumption than at present existed. Happily, as they were aware, they were well-provided with land for the purpose of erecting this gasholder, and as many more as there was any likelihood of the company ever requiring, and also for an indefinite extension of plant. At the last meeting they agreed to a reduction in the price of gas to 3s. 6d. per 1000 feet ; and he might mention, as a kind of warrant for the reduction then made, that there had been an increase in the rental for the half year of nearly £500, which showed that they were fully justified in making the reduction that they did on that occasion. In fact, unless the directors had seen their way they would not have recommended the shareholders to make a reduction, although they felt confident that whenever they made a recommendation which they considered as properly founded, the proprietors were always ready to accept their opinion and judgment with regard to it. There was another paragraph—a short but an important one, as it related to the increase in the salary of the secretary.

It was two years and a-half since addition was made, and the directors were all so well satisfied with the manner in which the secretary performed his duties that they were unanimous in the decision they came to on the present occasion. All those who were brought into contact with Mr. Ohren in an official capacity must be thoroughly satisfied that this gentleman was the right man, and, as he (the chairman) trusted, in the right place. He might also mention in connection with Mr. Ohren that this was not his silver wedding of matrimony with the company—it was one year more, as he had served the company faithfully, industriously. zealously and honorably for 26 years. The shareholders had all an opportunity of examining the accounts that had been placed before them with the report, and therefore he would move—

"That the report of the directors and the balance-sheet, confirmed by the auditors, be received, adopted, and entered upon the minutes."

Mr. F. L. Linging seconded the motion, and it was at once carried unanimously.

The deputy-chairman, Mr. H. P. Stephenson, then moved the declaration of the dividends as recommended in the report.

Mr. C. Lea Wilson seconded the motion, and it was carried unanimously.

On the motion of the chairman, seconded by Dr. F. Hedley the salary of the secretary was increased by the sum of £50.

The secretary begged to thank the directors sincerely for their kindness in proposing this increase to his salary, and the other proprietors for unanimously agreeing to the proposal, They all knew the great interest which the chairman took in the company. The chairman held one-fifth of the whole of the capital, and therefore when he spoke his remarks had great weight ; and he (Mr. Ohren) felt it a high honor to have testimony such as the chairman had just borne concerning him.

Gas for Heating and Motive Power.

A late number of the *Iron Age* indulges in some speculations concerning the comparative cost and advantages of gas over steam as a motor power, and also speaks of the superior usefulness of gas heat over steam heat for domestic uses—

"In small gas engines a horse power has been produced with less than 25 cubic feet of gas per hour, or, say, six cents per hour. Steam engines developing the same power can hardly be supposed to burn less than five lbs. of coal per hour for each horse power, or 0.01¼ cent. This makes a heavy showing, and to many persons a conclusive one, since it shows that the gas costs 4.8 times as much as the coal. It does not, however, really show this, for the mere running expense makes no account of the coal and kindling used for starting the fire, nor of the coal left on the grate at the close of the day. No account is taken of the cost or annoyance of removing the ashes, nor the dust and dirt which they occasion. If the figures are reduced below 10 pounds per horse power per hour, it would be, for a small engine, a surprisingly good result. This would make the two fuels stand as 2.4 to 1. In other words, for small engine users the gas engine will be as economical as steam when the price of gas falls to $1.40 per thousand. It must be considered that the cost of the steam for the small engine is the steam heating project to be reduced to a minimum, and that there is to be no steam boiler to trouble the user of small powers. This is true, but we apprehend that the small steam engines will not use less than 30 pounds of steam per hour for each horse power, and that the company will not be able to produce and deliver this quantity for less than three pounds of coal. When to this is added the profit and interest on a rapidly deteriorating plant, we think the cost of steam per horse power will be pretty high. Indeed, we cannot think that for engines of less than ten indicated horse power the charge will be less than two cents per hour for each horse power. At that price the gas engine, at the present rates for gas, would be the most desirable engine, though costing nearly three times more than the other to run. There are many things in favor of gas engines which are likely to bring them more and more into favor, and as their manufacturers improve them and make them more economical, they are likely to prove still more formidable rivals to steam.

"When we come to compare the value of steam and gas for heating purposes, the first cost is all in favor of gas. For steam heating not only must there be a pipe, but it is necessary to have radiators and return pipes, and certain complicated pieces of apparatus for measuring the steam and reducing its pressure. The latter we suppose will be furnished by the company, but the consumer will have to pay the interest and keep up the sinking and repair funds. The radiators cost a good deal of money and give more or less trouble. Against these difficulties we have to balance the advantages of gas. A cheap stove is all the apparatus needed. Wherever a gas pipe can be led the stove may be used. Where there is good ventilation, or where the heat is used for only a few minutes at a time, as in many sleeping rooms, the gas stove can be a portable affair, removable at any time, and the amount of fuel is a minimum. With the economy of such an apparatus steam can hold no comparison. Even with gas at $2.50 per thousand, it is cheaper than steam made in the most economical of boilers. For the various culinary purposes gas is not only much more economical than steam, but the apparatus is very much cheaper, and has the additional advantage of being well known and in use already.

"We expect to live to see the day when gas fit for heating purposes will be made at the mines and sent to tidewater or to the great seaboard cities in pipes. The saving in transportation will be very great, and the quantity used will be enormous."

The St. Lawrence Tunnel Scheme.

Notice was recently made of a scheme for tunneling the St. Lawrence River at Montreal. It is now reported that the scheme is likely to be abandoned in favor of a bridge, the English member of the Tunnel Company having joined a railway company holding a charter for a bridge across the St. Lawrence near Lachine.—*Sci. Am.*

THE

"STANDARD" WASHER-SCRUBBER.

The following are among the many English and Foreign Gas Companies Using these Machines:

	Ft. per Day.
The Chartered Gas-light & Coke Co., London—	
Beckton station	7,500,000
Bromley "	7,000,000
St. Pancras '	3,000,000
Shoreditch "	2,500,000
South Metropolitan Co., London—	
Greenwich station	2,500,000
Vauxhall "	3,000,000
Ditto "	3,000,000
London Gas Co., Nine Elms.	3,000,000
Altrincham Company	600,000
Bradford Corporation	3,750,000
Ditto	1,000,000
Bremen Co. (Germany)	150,000
Buxton Local Board	250,000
Cannes Co. (France)	200 000
Cheltenham Company	2,000,000
Deal Company	200,000
Derby Company	1,500,000
Dover Company	750,000
Driffield Company	100,000
Dudley Company	750,000
Dukinfield Local Board	500,000
European Co., Rouen	250,000
Falmouth Company	150,000
Frankfort Company (Germany)	300,000
Glossop Company	300,000
Goole Company	250,000
Harrow Company	250,000
Heywood Local Board.	600,000
Holywood Co. (Ireland)	125,000
Huy Co. (Belgium)	70,000
Ilkeston Local Board	250,000
Kidderminster Co.	750,000
Kingston (Hull) Co.	400,000
Leeds Corporation	14,000,000
Leominster Company	150,000
Leyden Co. (Holland)	560,000
Maidstone Company	1,000,000
Nottingham Corporation	1,250,000
Radcliffe Company	750,000
Ramsgate Local Board	1,000,000
Salford Corporation	5,250,000
Sydney Co. (Australia)	1,000,000
W. Bromwich Improvement Commissioners.	1,000,000
Woolwich Equitable Co	400,000
Yeadon Company	500,000
Yeovil Company..	250,000
QUEBEC CO., CANADA	250,000
NEWPORT, CO. (U. S. A)	250,000

WASHERS IN COURSE OF CONSTRUCTION:

	Ft. per Day.
The Chartered Gas-light & Coke Co., London—	
Bromley station.	2,000,000
Pimlico station.	2,000,000
Bradford Corporation (2 each of)	2,000,000
Bradford Corporation (2 each of)	1,000,000
Croydon Company	1,500,000
Dublin Company	3,000,000
Gloucester Company	1,250,000
Guildford Company	300,000
Halstead Company	150,000
Harrogate Company.	250,000
Heilbronn Company (Germany)	200,000
Liverpool Company	2,000,000
Nottingham Corporation	5,000,000
Oldbury Local Board	500,000
Plymouth Company	2,000,000
Smethwick Local Board	750,000
Sunderland Company.	1,500,000
Tunbridge Company	150,000
Willenhall Company	250,000
Weston-super-Mare Company	500,000
Waltham Abbey Company.	150,000
CITIZENS' COMPANY, NEWARK, N. J.	00,000
WILLIAMSBURGH COMPANY BROOKLYN, N. Y. (2 each of)	60 ,000
MUTUAL COMPANY, ST. JOSEPH MO.	250,000
CONSOLIDATED CO., BALTIMORE, MD. (2 each of).	1,000,000

The following Testimonials show the opinion of eminent Gas Engineers as to the capabilities of the Washer.

NEWPORT GASLIGHT COMPANY.
NEWPORT, R. I., May 30, 1881.

GEO. SHEPARD PAGE, ESQ.

DEAR SIR:—You may, in all cases, refer to our experience with your scrubber, with confidence that any inquiry will find the fullest endorsement of its performance here. I am more pleased with it the longer it works. It is doing its work thoroughly, efficiently, and sustainedly. There is absolutely no trouble or anxiety about it. It shows no sign of any obstruction or any increase of back pressure.

Yours truly, WM. A. STEDMAN, Treasurer.

GAS WORKS, PLACE D'ORLEANS,
QUEBEC, 18th June, 1881.

G. S. PAGE, ESQ., NEW YORK.

DEAR SIR: I have pleasure in testifying to the efficiency of the Standard Washer-Scrubber erected by you at our works. Clean water supplied at the rate of ten gallons per ton of coal carbonized, comes out 5° to 6° Twaddell, and tested with turmeric paper the gas is freed from Ammonia in passing through four chambers, leaving the other two as margin. We also find our purifiers much cleaner.

The machine is driven five revolutions per minute with the engine that does our pumping, exhausting, etc., so that it costs us very little for power.

I have letters from the Gaslight Companies at Newark, N. J., and St Joseph, Mo., inquiring about the "Standard" Washer.

Yours truly, D. H. GEGGIE, Sec'y and Manager.

GAS WORKS, PLACE D'ORLEANS.
QUEBEC, June 27, 1881.

GEO. SHEPARD PAGE, ESQ.

DEAR SIR: * * * * * * We are purifying 11,000 feet of gas per bushel of slaked lime, and our men say that in changing the purifiers they never found them so clean, showing that the Washer must take out a large proportion of sulphuretted hydrogen.

Yours truly, (Signed) D. H. GEGGIE, Secretary and Manager.

CONSOLIDATED GAS COMPANY, BALTIMORE, July 10, 1881.

GEO. S. PAGE, ESQ.

DAR SIR: After examining into the merits of the "Standard" Washer-Scrubber, as set forth in the various certificates of those having them in operation, and having given the principle of their working close consideration I have ordered two for this company, each having a capacity of 1,000,000 cubic feet in twenty-four hours.

Very truly yours, T. H. HAMBLETON, Engineer.

LEOMINSTER GAS AND COKE CO.
Sept. 15, 1881.

DEAR SIR: In reply to your letter of Aug. 24th, the Standard Washer has been in use in our works for more than a year and a half, and has quite answered our expectations. It has materially increased the illuminating power of the Gas, and has lessened the quantity of lime necessary for purification. The waste lime, when taken from the purifiers, is much less offensive than formerly, in consequence of the removal of the ammonia from the Gas before its entrance into the purifiers; and the quantity of ammoniacal liquor, which has now become a valuable product, is also much larger.

The Washer-Scrubber is driven by wheel and chain, by the Otto Gas Engine, which works the Exhauster; but only a small amount of power is required.

Yours truly,

(Signed,) JOHN F. SOUTHALL.

CORPORATION OF BIRMINGHAM,
WINDSOR STREET WORKS, Sept. 12, 1881.

G. S. PAGE, ESQ.,

DEAR SIR:— * * * * I beg to say that I believe all who have used the machine speak well of it.

Yours truly,

(Signed,) CHAS. HUNT.

THE SOUTH METROPOLITAN GAS COMPANY,
VAUXHALL, S. E., March 23, 1881.

G. S. PAGE, ESQ.

DEAR SIR:—In reply to your inquiry about Kirkham, Hullett & Chandler's Standard Washer, I refer you to the letter which is published in the Gas "Journal" as to the one erected at our Greenwich Works. *Here* I found a 3-million machine at work when I took charge in June last, and during the past winter it has been purifying from Ammonia 3½ million cubic feet per day.

I have erected another of these machines, to pass 3 millions in a different section of the works, driven direct by a 3 H. P. engine.

I need not say I am pleased with these washers, it is obvious.

Yours faithfully, F. J. WATES, Engineer.

The undersigned takes pleasure in stating that he is the sole representative in the Western Hemisphere of KIRKHAM, HULETT & CHANDLER, (LIMITED), of London, England, the proprietors of this valuable Patent.

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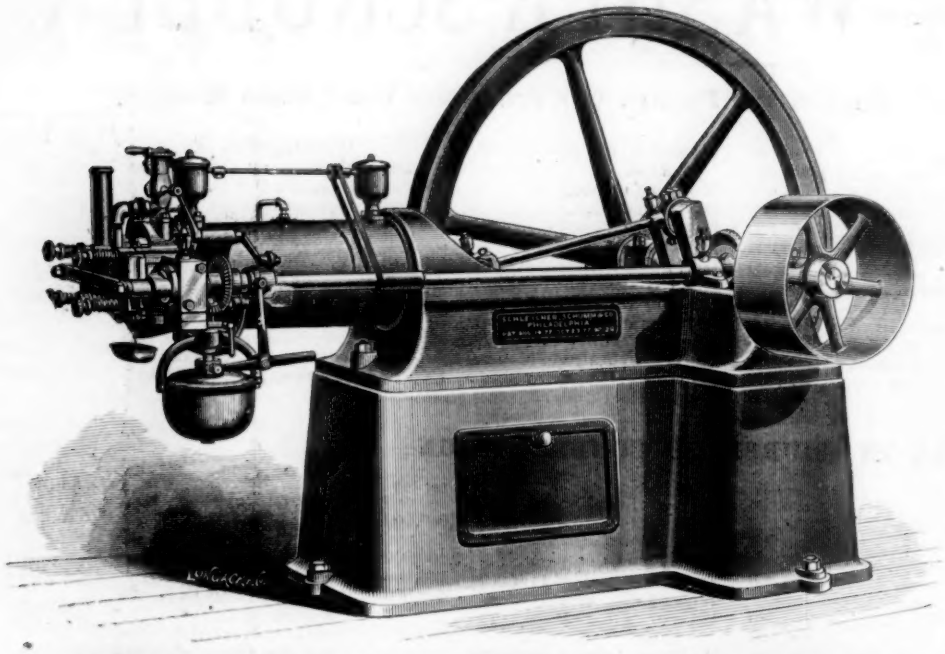

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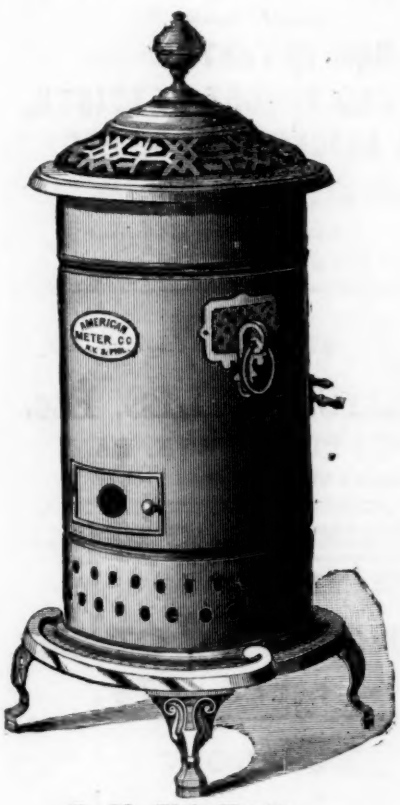

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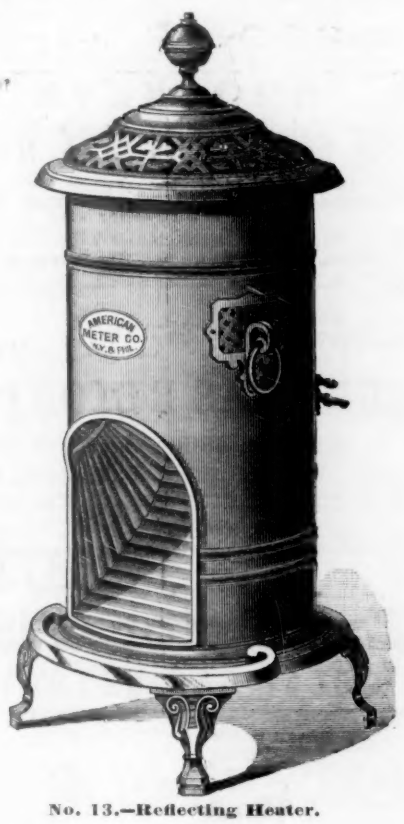

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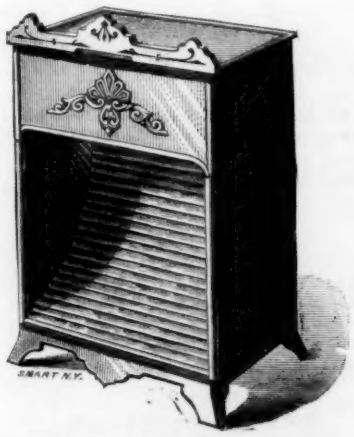

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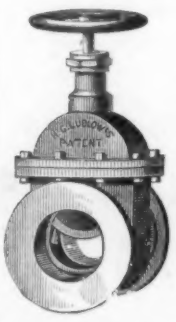

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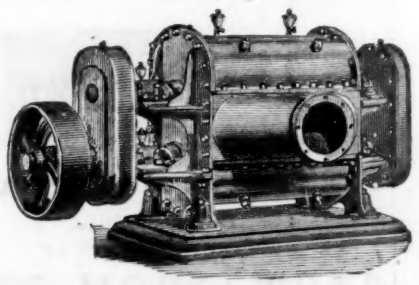

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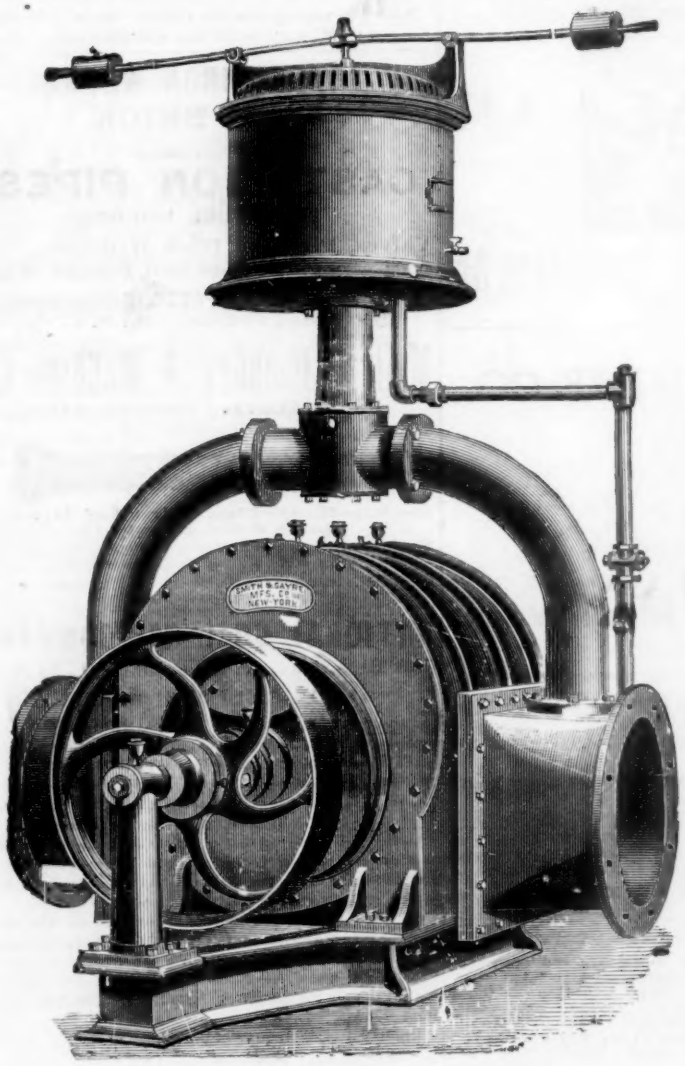

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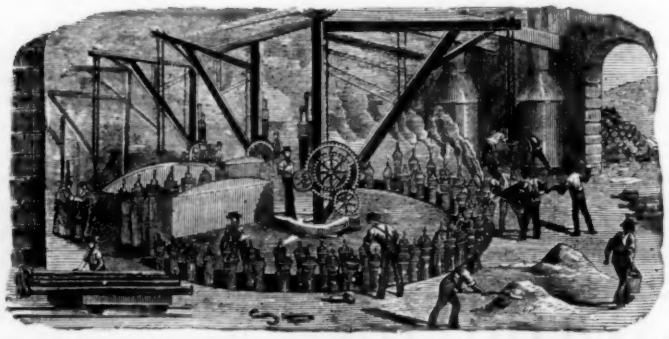

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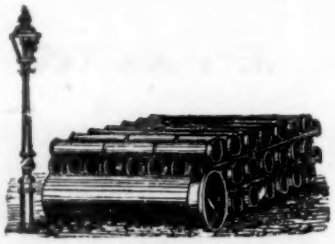

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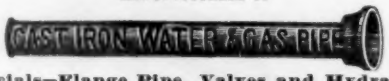

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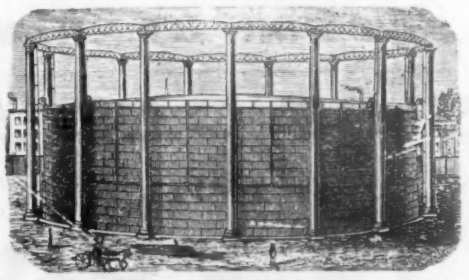

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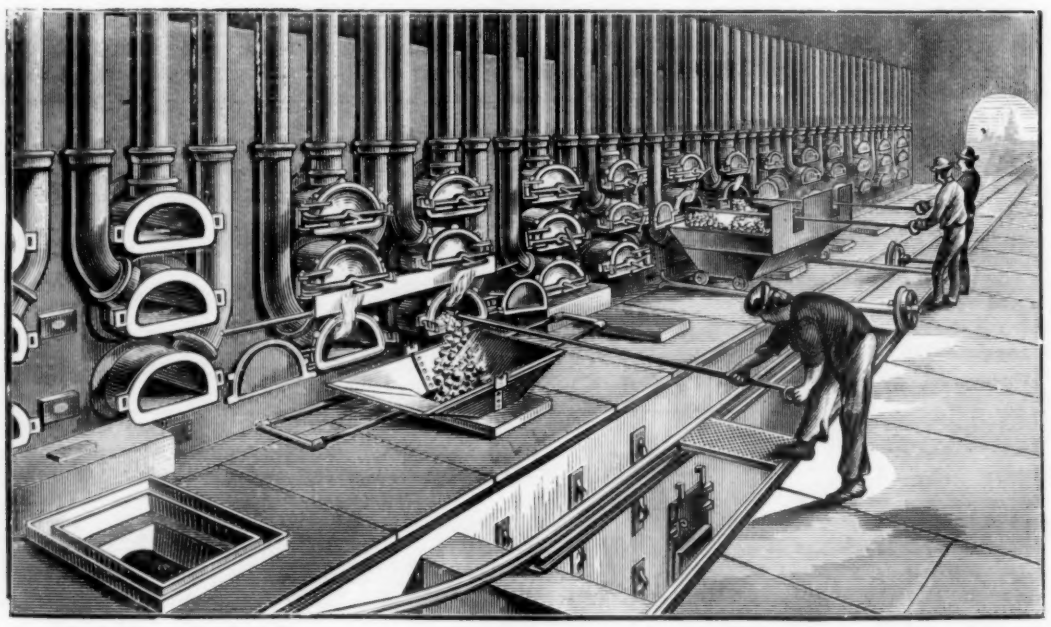

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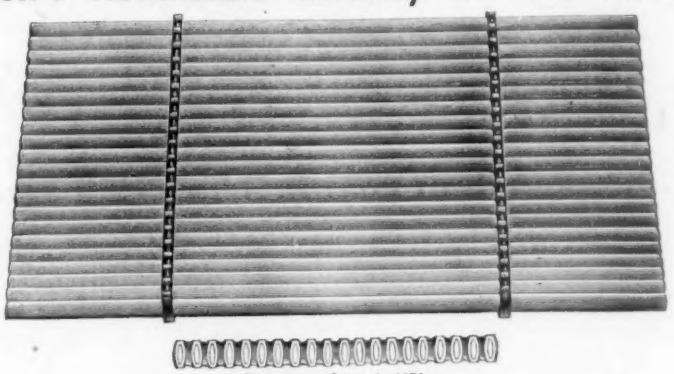

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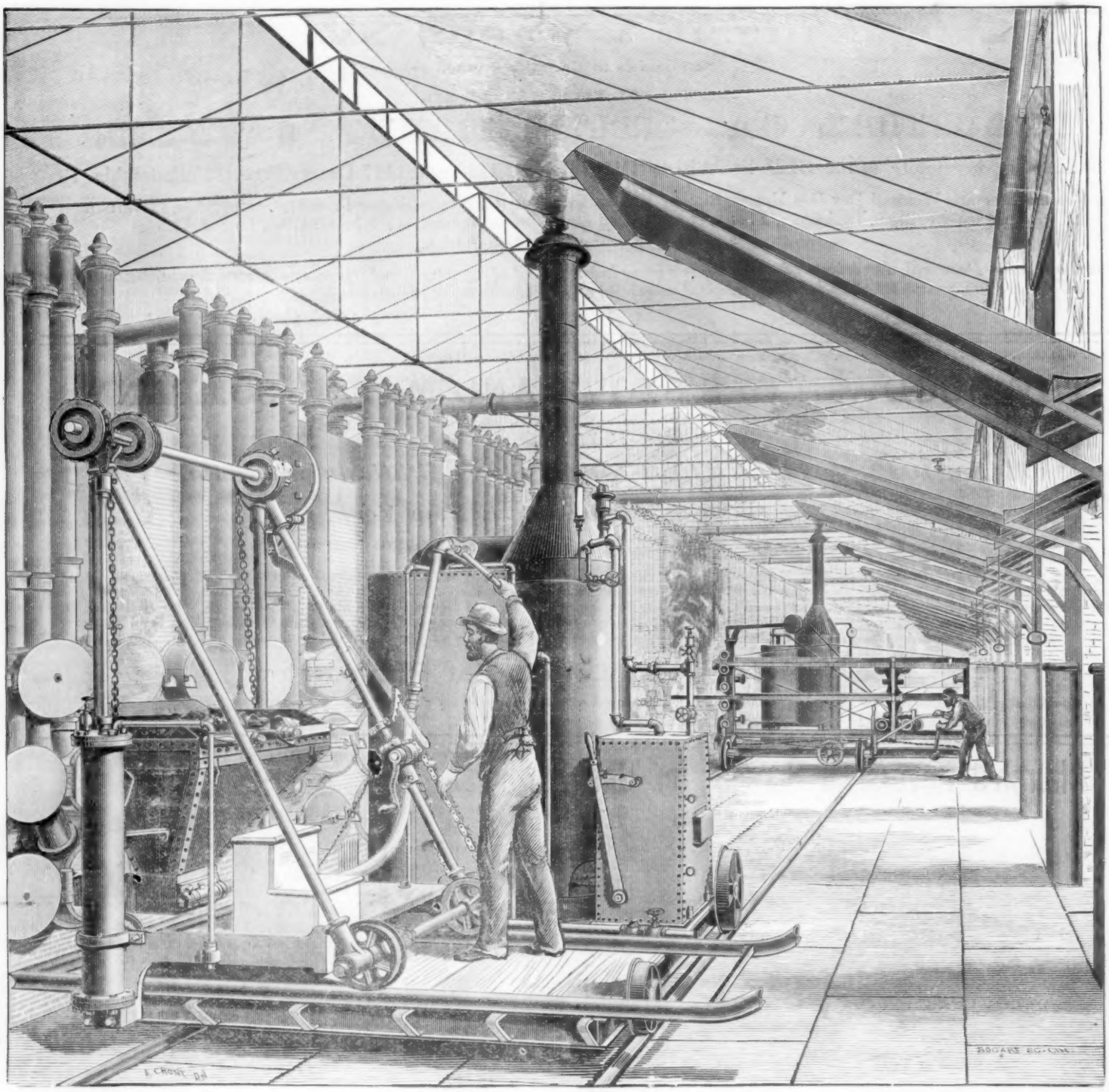

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